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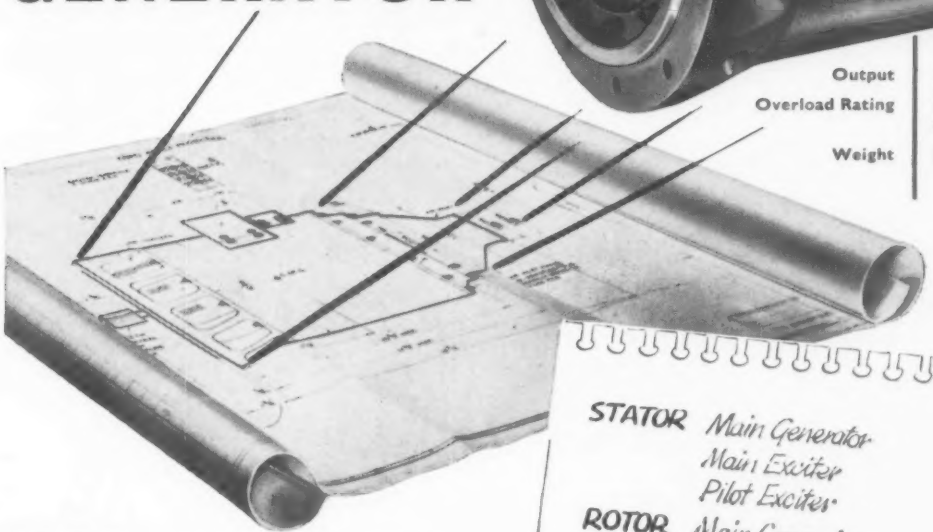

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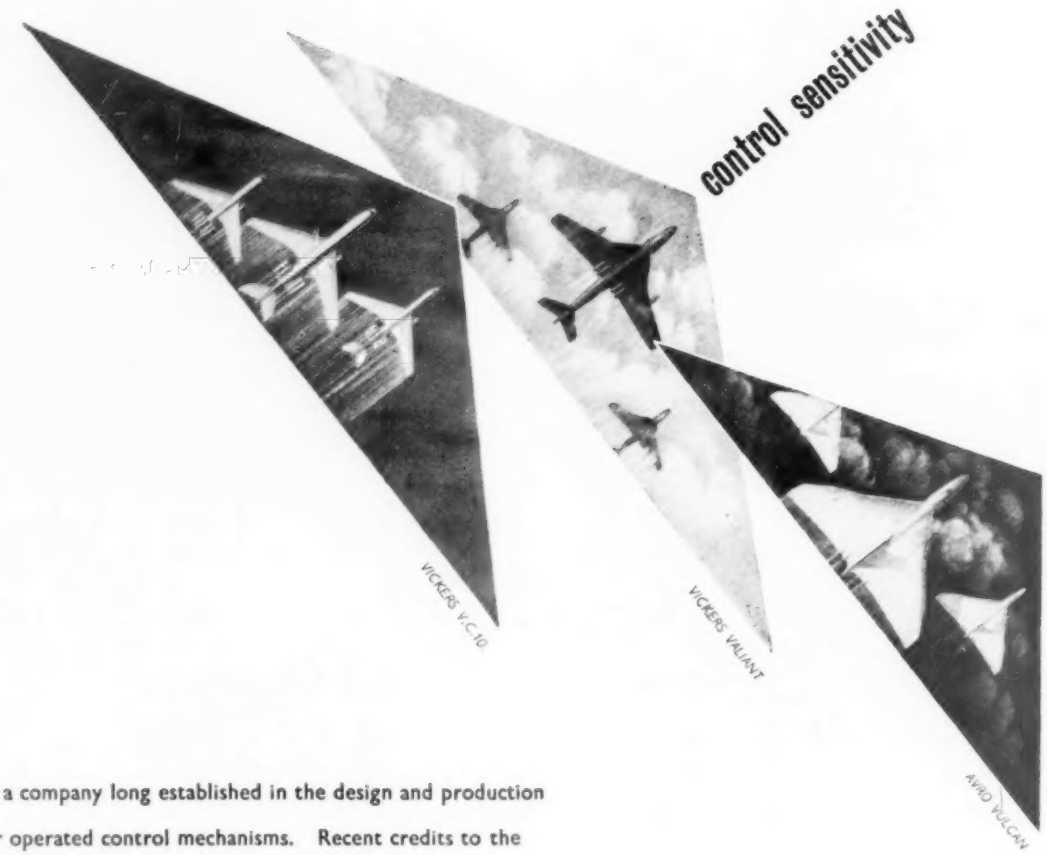

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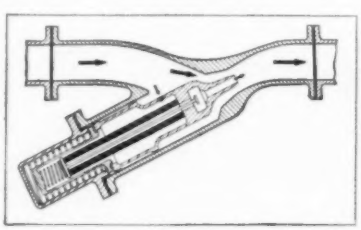

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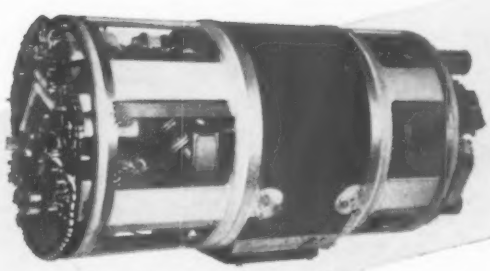

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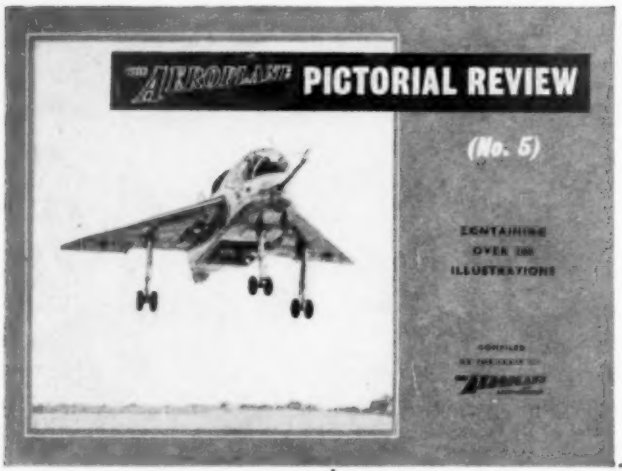

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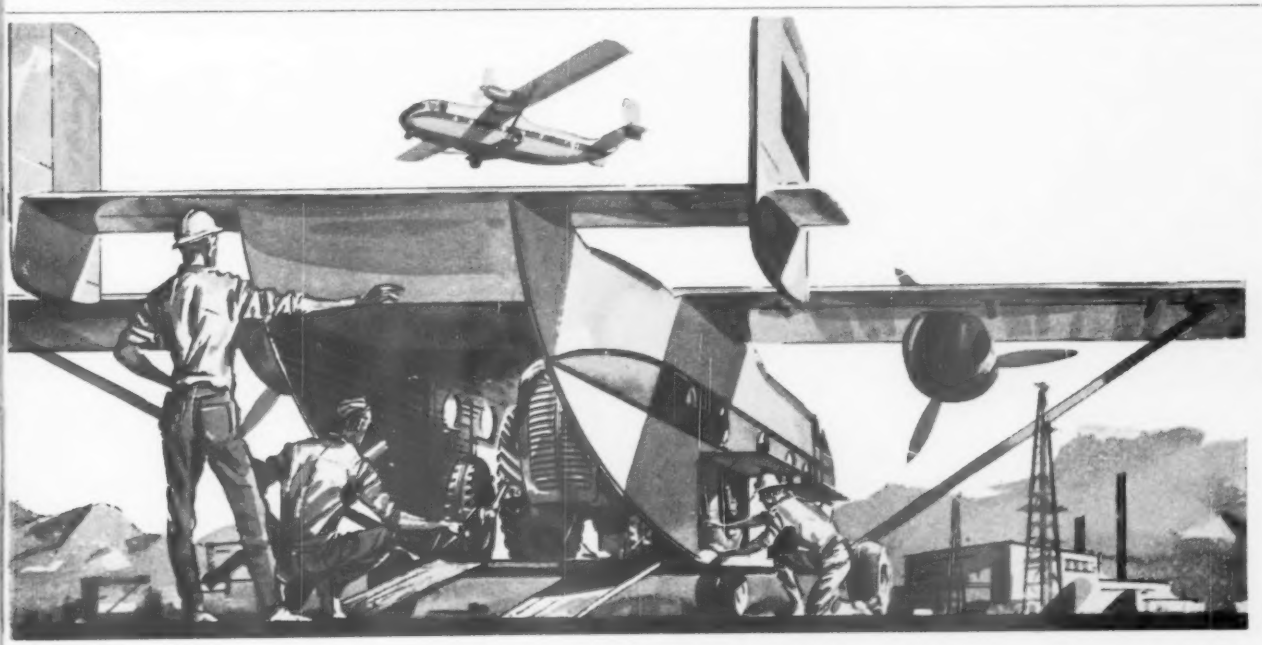

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THE AEROPLANE and ASTRONAUTICS

VOLUME 99 NUMBER 2563 DECEMBER 2, 1960

Franco-British Collaboration

Soon a decision will be made in Australia regarding new fighter equipment for the Royal Australian Air Force. The decision has been narrowed down to two aircraft: the Lockheed F-104, of which one variant has been chosen by the Luftwaffe; or the export version of the Dassault Mirage III which we describe this week.

If bought with the appropriate version of the Rolls-Royce Avon, the Mirage III, as supplied to the R.A.A.F., would provide a remarkable example of international collaboration. Its supply could foreshadow the way to the production of a French supersonic VTOL fighter, a development of the Mirage III with Rolls-Royce VTOL engines.

A Pioneer to Honour

Two weeks ago in London the new Historical Group of the Royal Aeronautical Society held its inaugural meeting. The lecture was given by that great pioneer airman and aircraft manufacturer Sir Thomas Sopwith.

Still alive, and vigorous in his retirement, is another pioneer aircraft constructor. Like Sir Thomas he was a balloon pilot before he took to making aircraft. He and his two brothers, now dead, gave their name to the great aircraft company, which for many years flourished on the Medway and is today linked with the shipbuilding industry in Northern Ireland, Short Brothers and Harland at Belfast.

Unlike Sir Thomas, Mr. Oswald Short, now in his 78th year, has not been knighted for his services to the country. What these services were has recently been recalled to us all by a lecture given in Belfast by a former Master of the Guild of Air Pilots and Air Navigators and a pioneer pilot who for many years was distinguished as a test pilot. In his lecture, the first Short Brothers Memorial lecture, Mr. Lankester Parker spoke of the work of the famous brothers. It is a good thing that the country should be reminded of what they did. And equally it is not unimportant to be reminded of how many years it took the youngest of the three brothers, and the only survivor, to persuade the Air Ministry that aircraft should be built of light metal, and that because of its characteristics, the metal should be used not only for structure, but as a stress-carrying covering.

This has been the accepted practice for so many years now that it is difficult to realize that even in 1927 British military aircraft were still fabric-covered metal and wooden-framed structures. Yet as long ago as 1919 Mr. Oswald Short had exhibited his all-metal Silver Streak at the Olympia Aero Show in London. From that pioneer work in stress-carrying metal-skinned structures grew all the distinguished family of Short metal seaplanes and flying-boats, culminating in the sleek, low-drag Empire boats.

We suggest that this story of belief in light-alloy stress-carrying skin structures is one which the Royal Aeronautical Society should invite Mr. Oswald Short to tell. It is only fitting that its new historical group should take the earliest practicable opportunity to record the voice of the pioneer constructor who, starting with balloons, and graduating through his association with the Wright brothers, lived to pioneer light-alloy stressed-skin construction in this country and to see his flying-boats crossing the Atlantic before the end of the 1930s.

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Matters of Moment

A Hall of Their Own at Last

TONIGHT Lord Brabazon of Tara, a past president of the Royal Aeronautical Society, will open the Society's elegant new lecture theatre (pictures on p. 730) and an address will be given by the president, Dr. E. S. Moult.

For years members of Council and staff have worked for the time when the Society could have a lecture hall of its own at 4 Hamilton Place, W.1, the Society's headquarters, instead of being forced to hold its major lectures elsewhere in London. In consequence the occasion, 94 years after the founding of the Society, is a real red-letter day.

A unique opportunity to build the lecture theatre arose when the redevelopment scheme for Hyde Park Corner was announced. During construction of the new Apsley carriageway behind the R.Ae.S. headquarters contractors would have easy access to the lecture-theatre site.

Consequently, in May last year the Society launched an appeal for £150,000 to build the lecture hall. Work on its construction began last October when donations, promises of support and covenants had come to about £90,000. In fact, it now appears that the lecture theatre will cost somewhat less than £150,000, but the appeal remains open as the grand total so far received or promised is just under £109,000.

Modern in concept and attractive in appearance, the lecture theatre is a great addition to the Society's facilities. It has seats for 316 people and, via closed-circuit television and remote loudspeakers, a further 500 can hear and see lectures. It has a flat floor and has been designed so that it can be used for social functions and exhibitions as well as for lectures.

Special attention has been paid to its projection and acoustic facilities. Its apparatus for projecting films and slides of all types is considered second to none. Its microphone system has been designed so that during discussions after lectures there is no need for speakers to leave their seats and march up to a rostrum. To ensure comfort the lecture theatre is fully air-conditioned.

Second Anglo-American Satellite

A NUMBER of British scientists left for the United States on Nov. 27 for discussions with NASA officials concerning instrumentation to be included in the first two Anglo-American satellites. Although equipment for the first satellite is now largely settled, one or two installational problems remain to be resolved. Launching is expected to be made from NASA's Wallops Island facility late next year.

Three experiments are known to be under consideration for the second satellite. The first, due to the Meterological Office, is concerned with the measurement of ozone in the upper atmosphere which forms a layer at 20 miles altitude, cutting off much of the Sun's ultra-violet radiation. The intention is to measure this radiation just before sunset when the rays just graze the atmosphere.

A micrometeorite experiment by Belfast University is suggested as the second experiment. Jodrell Bank scientists have proposed a third which would take the form of a lightweight "radio-telescope" for the purpose of measuring long-wave radio signals from remote space which do not penetrate to the Earth's surface. For this purpose, the satellite would be equipped with 200-ft. trailing aerials.

A SERVICE FAREWELL.—On Nov. 21, Viscount Ward of Witley (right)—until recently Secretary of State for Air—was the guest of honour at a dinner at Fighter Command headquarters. The C.A.S., Air Chief Marshal Sir Thomas Pike (left), presided; and among those present were members of the Air Council and the A.O.C.s-in-C. of all R.A.F. Commands at home.

Beagle Builds for the Future

WHEN British Executive and General Aircraft, Ltd. (Beagle) was formed in October with Mr. Peter Masefield as managing director (see THE AEROPLANE AND ASTRONAUTICS for Oct. 14) it was announced that part of the arrangements took the form of a manufacturing and technical liaison with F. G. Miles, Ltd., of Shoreham. Last week this initial proposal was taken a stage further and it was disclosed that the Beagle Group had acquired the aviation business of the Miles company. Mr. Masefield will join the Miles board as chairman; Mr. F. G. Miles becomes deputy chairman; and Mr. J. W. P. Angell becomes general manager. All the other executive directors of F. G. Miles, Ltd. will continue in their present posts and Mr. L. Blount also joints the board.

Mr. G. H. Miles, M.S.A.E., who is a member of the co-ordinating board of the Beagle Group has been appointed its chief engineer. And Mr. R. J. B. Woodhams, Wh.Sc., B.Sc., A.F.R.Ae.S., A.F.I.A.S., has been appointed the Group's chief designer.

R. J. B. Woodhams.

Mr. Woodhams, who is 44, started his aviation career in the planning department of the Armstrong Whitworth Company as soon as he left school. In 1937 he moved to Kingston and became a member of the Hawker drawing office. He took his engineering degree of London University three years later.

In 1944 Mr. Woodhams rejoined Armstrong Whitworth but a year later went to A. V. Roe as chief of projects. He joined the Air Service Training team at Hamble in 1951 and became its chief designer.

He went to Bristol Aircraft in 1956 as designer in charge and two years later became specifically interested in light aircraft design. In his new post with Beagle he will be responsible for leading and co-ordinating the whole design effort on the new range of Beagle executive aircraft.

Getting the Environment Right

WHEN, in the dim and distant past, someone disclosed the sad train of events which started with the loss of a nail from a horse's hoof it is most unlikely that he realized how accurately he had foreseen conditions that would apply in a later, much more technological, age. It is easy to be wise after an event; but even then it must have been obvious that a simple series of tests under realistic conditions would have prevented the disaster recounted, and the battle might never have been lost.

So it is today. One of the most important areas of technical development and pre-production work is the testing of the product in realistic operating conditions to ensure that when it goes into service in the operator's hands it will work properly and not prove to be unreliable. Nowhere is this more important than in aeronautical engineering. Equipment failures can be catastrophic and it is vital that everything possible should be done to see that they are not likely to happen.

For obvious reasons, it is not always possible either on the score of practicability, or economy, or even urgency, to do full-scale tests in actual operating conditions. And as a result, there has come into being a new science—some may prefer to think of it as an art—within the industry, that is concerned with the setting up of simulated environmental conditions in which realistic tests can be achieved in the laboratory or test house.

SOON FOR SERVICE.—Granting of a full British C. of A. for the Vickers Vanguard is now imminent and may be announced before this issue is published. Certification of the T.C.A. Vanguard 952, several of which are seen in this recent picture inside the new flight hangars at Weybridge, will follow a few days later.

In point of fact, so specialized has this activity become that two years ago those involved formed a professional association to facilitate the exchange of ideas and the dissemination of knowledge on this important subject. This robust group—the Society of Environmental Engineers—has been growing rapidly and during the past 18 months attendance at its lectures has shown an encouraging steady increase. The most recent of these was on Wednesday of last week, Nov. 23, at Imperial College when Mr. J. P. Salter, M.I.E.E., of the Armament Experimental Establishment at Fort Halstead, surveyed the problem of vibration testing and test instrumentation for large stores; he had an audience of specialists some 100 strong.

This was followed by the Society's first annual dinner—a most enjoyable and lively affair—at which the principal guest was Brig. H. S. Wood, T.D., deputy director of inspection (armaments) at the War Office. In proposing the toast to the Society he made the point that environmental testing was a comparatively new science which was beginning to loom large in the present order of things. Brig. Wood emphasized the need for Service equipment to work first time, and every time, in very rigorous environmental conditions—which, he added, were only just beginning to be understood. He congratulated the Society on its remarkable growth in so short a time.—F.T.M.

R.S.A. Honours the Lord Lieutenant

AT an informal ceremony at Buckingham Palace last week His Royal Highness The Duke of Edinburgh presented Sir Frederick Handley Page, C.B.E., Hon. F.R.Ae.S., F.C.G.I., Hon. M.Inst.T., Hon. F.I.A.S., Hon. A.R.I.B.A., with the Royal Society of Arts' Albert Medal. His Royal Highness made the presentation in his capacity as the Society's president and during the ceremony was attended by members of the R.S.A. Council.

The Albert Medal was instituted in 1864 to commemorate the Prince Consort's 18 years' presidency of the Society and it is awarded annually "for distinguished merit in promoting Arts, Manufactures or Commerce." Sir Frederick Handley Page received his medal "for leadership in the design and manufacture of aircraft."

He thus adds yet another high honour to those he has earned during his long and close association with British aeronautical history. As well as being the founder of the company which bears his name and responsible for a large number of renowned civil and Service aeroplanes, he has been a member of the Royal Aeronautical Society for no less than 52 years and was its president from 1945-47. He has been chairman of council of the City and Guilds of London Institute; is chairman of the board of governors of the College of Aeronautics; and is a governor and Fellow of the Imperial College of Science and Technology. Since 1956 Sir Frederick has been Lord Lieutenant of the County of Middlesex, a post from which he is shortly due to retire.

Airfields at Spitsbergen?

ON Nov. 12, "Tass" gave extracts from a Soviet Note delivered to Norway on Oct. 26 covering plans to build airfields in Spitsbergen. The Note referred to reports in the Norwegian and English Press concerning a Norwegian expedition to Spitsbergen in the summer of 1959. It was said that the North American Arctic Institute, financed by the U.S.A., took part in the expedition and that a wide survey was carried out on the possibility of building airfields in Spitsbergen which would be capable of taking modern heavy bombers. The English Press is reported to have stated that six airfields were planned.

The Soviet Government asked if there was any truth in the reports. The Norwegian reply delivered in Moscow on Nov. 9 reported the Foreign Minister's statement in the Norwegian Parliament on Jan. 27, 1959, "that the Norwegian authorities had no plans for constructing airfields on Spitsbergen nor of assistance for such work." This was still in force, the Note stated.

Many aircraft have used Spitsbergen over the years—Amundsen with his Dornier and other aircraft, including strengthened flying-boats taking off and landing on ice; the Norwegian-Italian "Norge" airship expedition; Andree's and other attempted balloon flights. During the last War, the Germans landed Ju. 88 and other aircraft on the snow in the Advent valley by Longyearbyen and one Ju. 88 still lies there. More recently, in 1959, the same strip was used by a Braathen DC-4; and there are reports that U.S.A.F. C130 aircraft used it in the unsuccessful nose-cone search.

There are not many promising sites for airfields on the archipelago. R.A.F. Catalinas landed at Green Harbourt near Barentsburg in the last War and there is an R.N.A.F. Christmas mail delivery (air dropped) most years.—F.J.F.

M.o.A's New Secretary

MR. H. HARDMAN, C.B., is to succeed Sir William Strath, K.C.B., as Permanent Secretary to the Ministry of Aviation. Sir William, who retires at the end of the year, is to join the board of Tube Investments, Ltd., and will become managing director of The British Aluminium Co., Ltd.

Born in 1905, Mr. Hardman, has been a Deputy Secretary in the Ministry since May of this year. He was educated at Manchester Central High School and Manchester University. From 1929 to 1934 he was lecturer for the Workers' Educational Association after which he was an economics tutor at Leeds University until 1945. In 1940, however, he had joined the Ministry of Food where he stayed until 1946 when he became deputy head of the British Food Mission to North America. In 1948 he was appointed Under-Secretary, at the Ministry of Food—a post he held until 1953. He then became Minister to the U.K. Permanent Delegation in Paris and from 1955 until May of this year he was Deputy Secretary to the Ministry of Agriculture, Fisheries and Food.

Matters of Moment . . . .

Aero-space Sciences and the Society

WHAT a tonic to read in a non-technical English magazine that we can now see clearly that we are entering on an entirely new "age of discovery" in which the so-called "aero-space sciences" are about to open new vistas to mankind. The article continues: "What results will come from this inevitable exploration of space we cannot tell. But all scientific history shows us that the new realms will immensely widen the horizons for humanity and bring new and unsuspected subjects for the pursuit of the mind of Man."

Later the author writes—"Space flight is sometimes shrugged off in this country as 'highfalutin' and of academic interest only as well as beyond our economic means. The fact is that in addition to its possibilities as an effective future means of world-wide commercial communications (by means of responder satellites), space activities have a most serious military potential. . . ."

These conviction-carrying sentences are taken from an article "Aviation, Space and the Future" by Peter G. Masefield in the current issue of the *National Provincial Bank Review*. We trust that they will be echoed many times in future editions of the journal of the Royal Aeronautical Society, of which Mr. Masefield is a past-president and a distinguished member of the council. Indeed, we hope that the Society will be at pains to emphasize its interest in the aero-space sciences. That is the field in which the rising generation wants a lead.

Already, research establishments are reporting difficulty in recruiting young engineers of the right calibre. Such men are not convinced that the aero-space sciences have any future in a country which refuses to assume its responsibilities in the exploration and utilization of space.

The British Commonwealth Lecture

A GREAT many unrecorded or forgotten items of historical aviation interest found mention as links in Mr. J. R. D. Tata's "Story of Indian Air Transport"—the 16th British Commonwealth Lecture.

Who, for instance, knew that the very first official air mail was flown in India on Feb. 18, 1911—four months before the historic Coronation Hendon to Windsor Castle mail flight? Most people, too, will have forgotten that the lecturer himself was one of the two pilots (the other was Nevill Vintcent) to fly the inaugural Tata Airlines' Karachi-Bombay-Madras mail service in 1932, and that the Indian Airlines Corporation, when nationalization came about in August, 1953, had to integrate eight separate airlines, with an assorted fleet of 99 aircraft, headquarters and maintenance bases in six cities, and a total of 7,017 employees. Nor may they have known that, less happily, these airlines were paid, by way of compensation, only the depreciated book value of the acquired assets—so that aircraft were obtained for as little as 20% of their true value—with only 10% in cash and the remainder in 5% bonds which were redeemed in 1958.

The uneconomically over-competitive post-War situation which led eventually to nationalization can be ascribed largely to the failure of the authorities to follow the plan put forward by Sir Frederick Tymms, the Director of Civil Aviation, in 1943. He estimated the total capacity required and recommended that post-War services should be entrusted to not more than four private operators, each with adequate routes and scope for development. These recommendations were discarded and the Licensing Board had, by mid-1947, granted approvals to 11 companies.

One of the landmarks in the 1946-53 period was the 1949 night airmail scheme in which services from Calcutta, Delhi, Bombay and Madras met at Nagpur to exchange mail loads. The idea was excellent as a means of rapid mail distribution, but it failed operationally because of lack of adequate facilities.

As Mr. Tata put it in his lecture, the only bright spot in the chaotic and sombre picture of post-War Indian air transport was the solid success of Air-India International, which started long-haul international operations in June, 1948, as a joint State (49%) and private (51%) enterprise. It made a profit during each but one of its four years of life prior to nationalization, and has continued to do so since.

ADVERTISING MANAGER.—Mr. Clifford Hollowell who has been appointed advertising manager for the British Aircraft Corporation; until recently he was joint deputy publicity manager of English Electric and prior to that publicity manager of D. Napier and Sons Ltd.

Design Features of Black Knight

A COMPREHENSIVE lecture outlining the development of the R.A.E./Saunders-Roe Black Knight was given before a meeting of the Luton Branch of the Royal Aeronautical Society by Mr. D. J. Lyons on Dec. 1.

Among new information contained in the lecture was the fact that Black Knight relies upon an external monitoring system without a programming unit to control heading. Main guidance is achieved by command-controlling the vehicle to follow a radio beam aligned to the desired elevation and azimuth cut-off. The elevations and azimuths are selected to give impact about 60 miles downrange from the launching point.

No engine cut-off signal is supplied from guidance information and the tanks are allowed to run to depletion. Command-control is only exercised in the pitch and yaw planes; the auto-pilot is relied upon to hold the missile roll stabilized with sufficient accuracy so that angular phasing errors between pitch and yaw signal commands do not cause instability.

Another revelation is that the two-stage Black Knight employs basically the same type of Cuckoo solid-propellent rocket motor as the boosted Skylark. Like the Skylark sustainer motor, this was developed by R.P.E., Westcott. In the Black Knight top stage configuration, it has an overall length of 3 ft., a diameter of 1.4 ft., and a burning time of approximately five seconds.

Seven Argosies for Riddle

RIDDLE AIRLINES of Miami has now completed the financing of its $12 million contract with Sir W. G. Armstrong Whitworth Aircraft, Ltd., for seven Argosy turbo-prop freighters. The airline has also taken an option on eight more Argosies.

All seven aircraft have already been completed as part of the original batch of 10 laid down by Hawker Siddeley in a £10 million private-venture development programme. Delivery is scheduled to be completed by April, 1961, with the first aircraft expected in the U.S.A. before the end of this year.

The Argosies will be used on Riddle's Logair contract, started last July and worth $25 million over three years, for the transportation of outsize military cargo between U.S.A.F. bases in North America. Riddle pilots and an F.A.A. representative have already flown the Argosy in the U.K. and an A.W.A. pilot is going to Miami to assist in further training. The instruction of ground personnel has begun in the U.S. and at Coventry.

Sir Thomas Sopwith Looks Back

IN the lecture theatre of the Institution of Mechanical Engineers before a packed audience containing many pioneers of 1910, Sir Thomas Sopwith gave on Nov. 21 the opening lecture to the R.Ae.S. Historical Group. Dr. E. S. Moult, the President, vacated the Chair in favour of Mr. Peter G. Masefield, in whose term of office the lecture would have been held but for Sir Thomas contracting chicken pox last May.

Sir Thomas began by saying that when a year ago he was asked to talk on his first ten years in aviation he hesitated as memory was becoming dimmed. So he asked his old friend Geoffrey Dorman to help and between them they had put a talk together with 47 lantern slides.

His interest in flying started when he and his engineer, Fred Sigrist, were sailing in the Channel and, becalmed off Dover, they put into the harbour and heard an aeroplane was down in a field behind the town so they went to see. It belonged to an American, Johnny Moisant or Moissant. The pilot's name was spelt with one "s" in the Aero Club de France list of Aviators' Certificates, some papers gave him one "s" and some two. So Geoffrey Dorman, then an inquisitive teenager, asked for his autograph when he finished the flight at Beckenham and the pilot spelt it Moissant.

When the Blériot resumed its flight, Sir Thomas said it started something in him and he *had* to fly too. So he went to Brooklands and paid a fiver for two circuits *inside* the track with the Frenchman Gustav Blondeau in a Farman. That did it. He was bitten by the aviation bug never to recover. He bought a Howard Wright Avis monoplane and taught himself taxi-ing. A vehicle had just come on the London streets which bone-headed bureaucrats called the taximeter-motor-cabriolet

Flying the Howard Wright Avis at Brooklands.

which the public shortened to taxi. So the Brooklands pilots adapted the word to their own use, on the initiative of that great pilot and character D. G. Gilmour, so C. G. Grey had once told Sir Thomas.

He crashed the Avis so bought a larger Howard Wright biplane and taught himself to fly on it. And in three weeks, on Nov. 22, 1910, he took Aviator's Certificate 31.

Crashing the Avis and buying the biplane was expensive so he decided to try to get money back by going for the Baron de Forest £4,000 prize for the longest flight from England to the Continent. The Baron, now Count de Bendern, aged 81, lives in Biarritz.

Fred Sigrist had a theory that the most likely time for an engine to fail was in the first few minutes of full throttle and advised the young Tommy Sopwith to start from Eastchurch which would mean about half an hour over land before the sea crossing; so at 08.30 on Dec. 18, 1910, he took off from Eastchurch. His compass insisted pointing N.W. no matter how he turned so he steered by the sun; and when it was hidden by cloud he went as best he could. He crossed the Straits safely but never knew where he made his landfall. He flew on but rising wind made it very bumpy. He held on with one hand as there were no seat-belts then and when it got too rough he landed near Beaumont in Belgium. "I was getting frightened!" confessed Sir Thomas. He had flown in all 169 miles in a straight line. Then the weather clamped right down and no one beat him so he won the prize.

Telling of the lack of frustrations in those days he showed a slide of Claude Grahame-White landing his Farman in a street in Washington. And he recalled how he himself bet a number of friends in the Aero Club, then in Piccadilly opposite the end of Bond Street, that he would lie on his back in the middle of Piccadilly for five minutes without being moved on. Cars could then be parked in the middle of the road so he lay under his for five minutes and won his bets!

In 1911 he visited the U.S.A., competing in flying meetings at Chicago, Boston, and New York where he cleaned up a lot of prize money. And with the de Forest £4,000 in the bank he began thinking of forming his own firm. "It is difficult to give an exact date to the start of Sopwith Company—like Topsy 'it just growed'," he said. But his was the tiny seed that was to grow into the great Hawker-Siddeley Group.

He told of the gradual growth of the firm and how four Australians came to England to study flying, one of whom, Harry Hawker, he taught to fly. He told how "Boom" Trenchard came to him to get his Certificate in 10 days or he would be over age to join the R.F.C.

He told how he himself won the first Aerial Derby. And how, after winning the 1914 Schneider Trophy contest in the Sopwith Tabloid on floats, "Picky" Pixton on being offered the hospitality of the Monaco Sporting Club and to name his drink, mumbled "Thanks very much. Mine's a small Bass." And he told how surprised were the "master minds" at Farnborough when the Tabloid showed a greater speed range than any other aeroplane.

Then he told of the famous Sopwith fighters of the Kaiser War, from Pup to Snipe, and showed slides of lesser-known types.

When the War ended in 1918 and there were no more military or naval orders and no civil aviation, he told his board the Sopwith firm must be wound up while still solvent which was done. Then a new firm was founded named after Harry Hawker to prevent confusion with the Sopwith firm in liquidation.

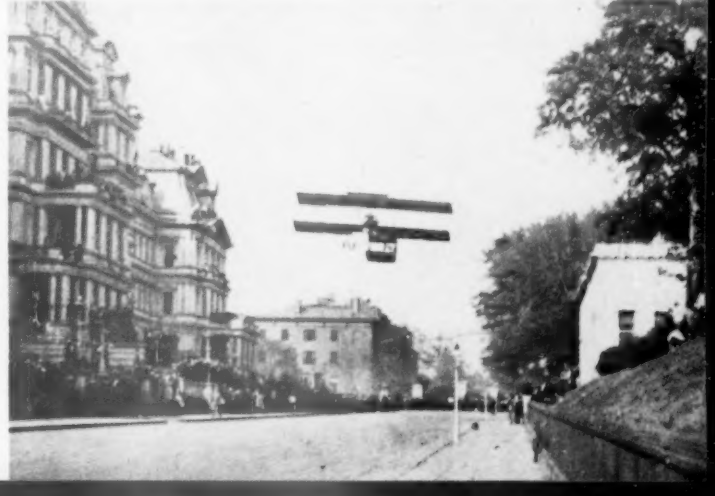
"Our object was to keep it small, to make aircraft when there was a need, and keep the wheels turning by building motorcycles and a few other odd jobs," declared Sir Thomas. "But things happen. Look at the damned thing now!"

He then glanced at the future and said boys of today were growing up reading space fiction, just as he himself grew up reading air fiction. The R.Ae.S. should have their eyes on those boys as they would be the spacefarers of the future. "It is a solemn thought," he declared, "that even if man can ever travel at the speed of light he can only potter about locally among our own planets or a few of the nearer stars. And at a penny a mile you'd need a pretty fat expense account to reach the Moon for £1,000 and the same to come back. And the single fare to Venus would be £100,000 and double that to Mars. We must look to the youngsters of today, and those yet to be born, to reach outer space—and sort out the economic problems too."

The meeting was then thrown open to questions—and the authors of the paper must have feared that this was where their clangers would have been paraded. But, miraculously, not one was revealed. That was probably because the paper had previously been circulated to many of Sir Thomas's old associates and to the Historical Group too. And facts were checked over and over again. Evenings to discuss the paper are being arranged for early in the New Year.

After the paper the R.Ae.S. gave a private dinner party to a few of Sir Thomas's old friends and associates. Among those present were Lady Sopwith and young Tommy (T. E. B. Sopwith), Sir Geoffrey de Havilland and Sidney Sippé who flew in that first Aerial Derby—"Looking half his age!" declared Sir Thomas.

Dr. Moult presided and after-dinner stories of the old days



STREET LANDING.—Claude Grahame-White landing (intentionally) in a Washington (U.S.A.) street.

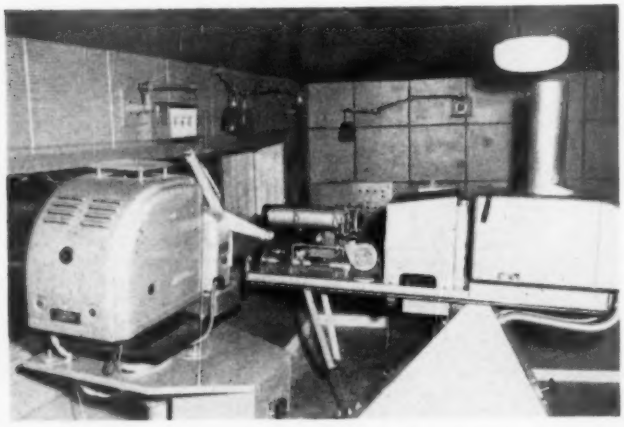
were told and Sir Thomas told several amusing ones of the "proverbial" meanness of the Hon. C. S. Rolls. And Geoffrey Dorman told how C. G. Grey had written, anent the Committee of the Royal Aero Club: "Why is it that when you get a number of apparently sane and intelligent men and form them into a committee, they become—as a committee—one collective congenital idiot?" So C. G. G. was summoned before the committee and asked to withdraw his remark. He listened patiently to all the committee had to say, and when asked if he would withdraw that remark he rose to his full height of more than six feet. He screwed his eyeglass into his eye, beamed all round at the committee. "Having said what I wanted to say, I now withdraw!" he declared, and tucking his papers under his arm he sailed out of the room leaving the committee wondering who had won the day.

It was a wonderful, nostalgic occasion, the day of the Sopwith Story, and none who were lucky enough to be there are likely to forget it.

New £150,000 Lecture Theatre for R.Ae.S.

To be officially opened by Lord Brabazon of Tara on Dec. 2, the new lecture theatre building of the Royal Aeronautical Society at 4 Hamilton Place, London, W.1, provides facilities which the Society believes to be unparalleled by those of any other professional institution in the country.

Panelled in the modern version of linenfold in olive-ash wood, the lecture hall will seat 316. Closed-circuit television is provided for 500 more. Seats are dark blue and the parquet floor is red-carpeted.



Above, two speaker's desks are provided on the rostrum. Screens and blackboards are concealed until required. Left, at the back of the hall, are the projector and translators rooms. Round the walls are crests symbolising branches and divisions. Left middle, inside the projector room.

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Air Transport

Enter the Convair 990

EXPECTED to make its first flight in January, the first Convair 990 was rolled off the final assembly line at San Diego last week and moved to a laboratory hangar for the completion of pre-flight testing. Announcing the roll-out, Convair also indicated that the company has now adopted American Airlines' nomenclature for what was originally called the Convair 600. With 25 on order, American Airlines had objected to a later model of the Convair 880 having what appeared to be an older designation. The intercontinental version will be known as the Coronado 990, a name originally coined by S.A.S. and Swissair.

The photograph on this page shows the speed capsules which are a distinctive feature of the 990 and which allow Convair to claim this aircraft to be the "world's fastest airliner with a maximum level cruising speed of 640 m.p.h." The design limit cruising speed is Mach 0.91, compared with the Boeing 720's Mach 0.90.

Other changes in the 990 from the basic 880 design are an increase in wing chord to reduce the effective thickness/chord ratio and to provide the necessary greater wing area for increased operating weights; leading-edge slots and larger spoilers; a "slight reflex" on the tips of the wing trailing edge; a proportional anti-skid braking system; increased fuselage length (from 129 ft. 4 in. to 139 ft. 5½ in.); and increased fuel capacity, with tanks in the four speed capsules on the wings. Total fuel capacity of the Convair 990 is 12,580 Imp. gallons, and of the Coronado, 13,050 Imp. gallons.

Gross weight of the domestic 990 is 239,200 lb., but a further increase has recently been made in the weight of the intercontinental Coronado to 244,200 lb.—the greatest weight so far announced for any of the Convair jet transports. Power is provided in both versions by four 16,100 lb. General Electric CJ-805-23 turbofans with thrust reversers. Range of the 990 with a 25,120 lb. payload (96 first-class passengers and baggage) is given as 3,734 naut. miles using long-range cruise procedure at 35,000 ft. with normal airline reserves.

Orders for the 990 total 37, of which 25 are the domestic version for American Airlines (with 25 more on option); Coronado versions have been ordered by Swissair (7), S.A.S. (2) and Real Aerovias (3).

Production of the earlier Convair 880 and 880-M is meanwhile nearing completion, and Convair is still embarrassed by the failure of T.W.A. to conclude its purchase of the 30 aircraft originally ordered. While Howard Hughes, whose Hughes Tool Co. actually placed the contract with General Dynamics Corp., continues to seek a means of financing this and other T.W.A. equipment deals, the aircraft are complete and idle at San Diego. Convair also has been hit by the failure of Capital Airlines to complete its proposed purchase of seven 880-Ms, and the difficulty of several prospective South American customers in arranging adequate financing. Convair's loss on its jet transport programme was recently estimated to have reached $221 million.

The Neglected Market

FIVE years ago the World's major airlines were too busy planning for the turbojet era—and too concerned with finding the means to finance this era—to consider the encouragement of the type of aircraft which would offer the prospects of the lowest possible fare structure. Now, it seems, these same airlines are going to be busy for the next decade in planning (and finding the money for) the jump into the supersonic era.

When the turbojets were being planned the airlines really did believe that the prospective work capacity of this aircraft would automatically lower fares—but they cannot have the same illusion about the supersonic aircraft. The best that can optimistically be hoped for is that the operating costs will be no higher than those for existing subsonic turbojets—so there is just a chance that the airlines will find it essential to plan, at the same time, for new bread-and-butter aircraft for the mass travel market. These will probably be very big units—so as to keep the seat-mile costs down—and will be expensive to build and to buy.

In an article in the National Provincial Bank *Review*—concerned largely with supersonic transport prospects—Mr. Peter Masefield stresses the need for commercial aviation interests to pay equal attention to the low-cost subsonic transport.

"The fact is," he writes, "that no aircraft manufacturer has ever been asked by an airline to build the aeroplane which would make possible, profitably, the lowest fare structure attainable regardless of speed or configuration. Were such a request made, the most economic speed at present would probably come out at around 480 m.p.h.—using ducted fan engines.

"The Vanguard—built by Vickers to a B.E.A. requirement—is perhaps the nearest approach to this low-fare ideal. An extension of the requirements might well produce fares which could be profitable some 30% lower than today's levels—whether first-class, tourist or economy class.

"The problem is not so much that of technology but rather the inflexible nature of the fare-fixing 'ring' in the International

SPEED MERCHANT.—This striking view of the Convair 990 (see above) on its recent first appearance shows the speed capsules (anti-shock bodies) on the wings, and the squat nacelles for the General Electric aft-fan engines. The first flight is expected in January.

Air Transport . . . .

Air Transport Association. Lack of a permissible fare structure has meant lack of demand for the low-fare aeroplane which would use advanced technology to bring down costs rather than push up speeds.

"The advent of the supersonic airliner, and the clear division which must then result between subsonic and supersonic flying, may precipitate 'The Great Divide': on the one hand supersonic travel at premium fares at around today's levels, on the other 'Lofair' services at subsonic speed and substantially cut fares.

"Such an approach could, I believe, give a further great fillip to the advance in the World's air traffic."

Independent Merger

AIR SAFARIS and Don Everall Aviation have merged their airline interests, and Mr. Don Everall is joining the board of Air Safaris—the name under which the combined organization will operate.

The main base and head office is at Gatwick Airport, but, at least until land can be obtained for hangar accommodation there, the engineering centre will be at Hurn Airport, Bournemouth. Birmingham Airport (Don Everall's base) will continue to be used for scheduled and other activities. Previous to the merger Air Safaris had acquired Falcon Airways' two H.P. Hermes and hangars, equipment and workshops at Hurn. The joint fleet will consist of three Hermes and six Vikings.

Air Safaris has approval for services from Hurn to Dublin and Amsterdam, and Don Everall for seasonal holiday services from Birmingham/Coventry to the Channel Islands and from Birmingham to the Isle of Wight and Exeter.

Qantas Sells its Surplus

ONE class of operator that seems to have benefitted from the big jet re-equipment programmes of larger airlines is the U.S. supplemental or non-scheduled carrier. U.S. operators in this class are in a favourable position to take their pick of surplus piston-engined equipment traded-in to American manufacturers against turbojet and turboprop orders.

This is illustrated by the disposal of Qantas' Super Constellations. Eight have been sold in the past year. Three L-1049Es have gone to Twentieth Century Aircraft, Inc., who operate as Twentieth Century Airlines with a fleet of two ex-American Airlines' DC-6Bs and seven DC-4s. One L-1049G has been sold to Resort Airlines, Inc., who concentrate on military charter work and on inclusive tours to the Caribbean, and a L-1049E has gone to Capitol Airways, Inc. (not to be confused with Capital Airlines), who already own one L-1049G (not ex-Qantas), three L-749As and 17 C-46s. Two of five Qantas DC-4s have been sold to Zantop Air Transport, Inc., another U.S. "non-sked."

Of the remaining eight Qantas L-1049s, two are being converted to L-1049H freighters by Lockheed Aircraft Services for the Sydney-London all-cargo run, and another is leased to Malayan Airways (in which Qantas has a 32% holding) to operate a twice-weekly Singapore-Hong Kong service. Two of Tasman's four weekly services between Auckland and Nandi are operated by Qantas L-1049s on charter, and the four Otters and six of the eight DC-3s have been turned over to T.A.A. which is now operating Qantas' New Guinea services.—M.J.H.

Accident Follow-up

MORE information is now available about the causes and consequences of some recent accidents to transport aircraft. The details are summarized here.

S.A.A. BOEING 707. Making a bad-weather approach to Embakasi on Oct. 30, this aircraft hit the ground about 1½ miles short of the runway, damaging the nosewheel, but remained airborne. The captain subsequently elected to make a wheels-up landing on the runway—possibly because he was uncertain about the state of the main undercarriage. Considerable damage was suffered by the aircraft and engines, but there were no casualties.

ARCTIC-PACIFIC C-46. Following the accident on Oct. 29 at Toledo, Ohio, in which 22 of the 48 occupants were killed, the F.A.A. suspended this carrier's operating certificate and filed a complaint with the C.A.B. giving its reasons for doing so. These included, according to the F.A.A., the fact that the C-46 took off 2,000 lb. overweight and in weather conditions far below the authorized minima. The captain and first officer had both been on duty on Oct. 27 and 28 beyond the C.A.R. flight time limits and the captain's licence had been revoked last July by the F.A.A. On Oct. 27, Arctic-Pacific advised the F.A.A. that the captain had been discharged.

The C-46 was equipped with a military surplus-type engine which was not modified in accordance with F.A.A. regulations and had not been properly inspected or maintained.

EASTERN AIR LINES ELECTRA. Although the theory that a large flock of starlings caused this accident at Logan Airport, Boston, on October 4, is widely supported, the C.A.B. investigation to date is not conclusive. Wreckage recovered from the harbour showed that No. 1 engine had been shut down and its cowling had a large dent that may have been caused by a seagull. The remaining powerplants showed evidence of being in normal operation at the time of impact, but may have faltered seconds before the crash. Areas of study by the C.A.B. include the elevator boost system, on which a problem recently came to light, and the whole question of cockpit management and human reaction—"what happens when the windshield is suddenly plastered with birds . . . where do all the hands go?"

According to Lockheed chairman Robert E. Gross, it "appears that the air intakes, scoops and flap openings literally were smothered by the feathers and bodies of thousands of birds." An Allison spokesman said that tests showed bird ingestion by the engine could cause a power loss of as much as two-thirds of an engine's total output for a period of 3-5 seconds.

Several other "bird" incidents have been reported at Logan Airport. On Apr. 4, according to a C.A.B. investigator, an American Airlines Electra struck birds after becoming airborne and was forced to return to the airport after feathering one engine. On Nov. 19, an Eastern Air Lines DC-8 hit a flock of birds as it began to roll down the runway, and returned to the ramp for inspection. Intensive measures are now being adopted to keep the runways clear.

BRANIFF AIRWAYS ELECTRA. A suit for $2,400,000 damages has been brought by Braniff against Lockheed and Allison as compensation for the Electra which crashed after structural failure on Sept. 29, 1959. The suit claims that there was negligence in the design and manufacture of the aircraft and that the Electra could not be flown safely at its designed cruising speeds.

JET SUPPORT.—Scottish Aviation Ltd. recently converted this Aer Lingus DC-3 to allow it to transport spare JT3C-7 engines for Irish International's Boeing 720s. The enlarged freight door provides for easy loading of the trolley-mounted engine; the floor level at the rear of the cabin has been raised to reduce the gradient and a winch behind the forward cabin bulkhead pulls the trolley to its tie-down points.

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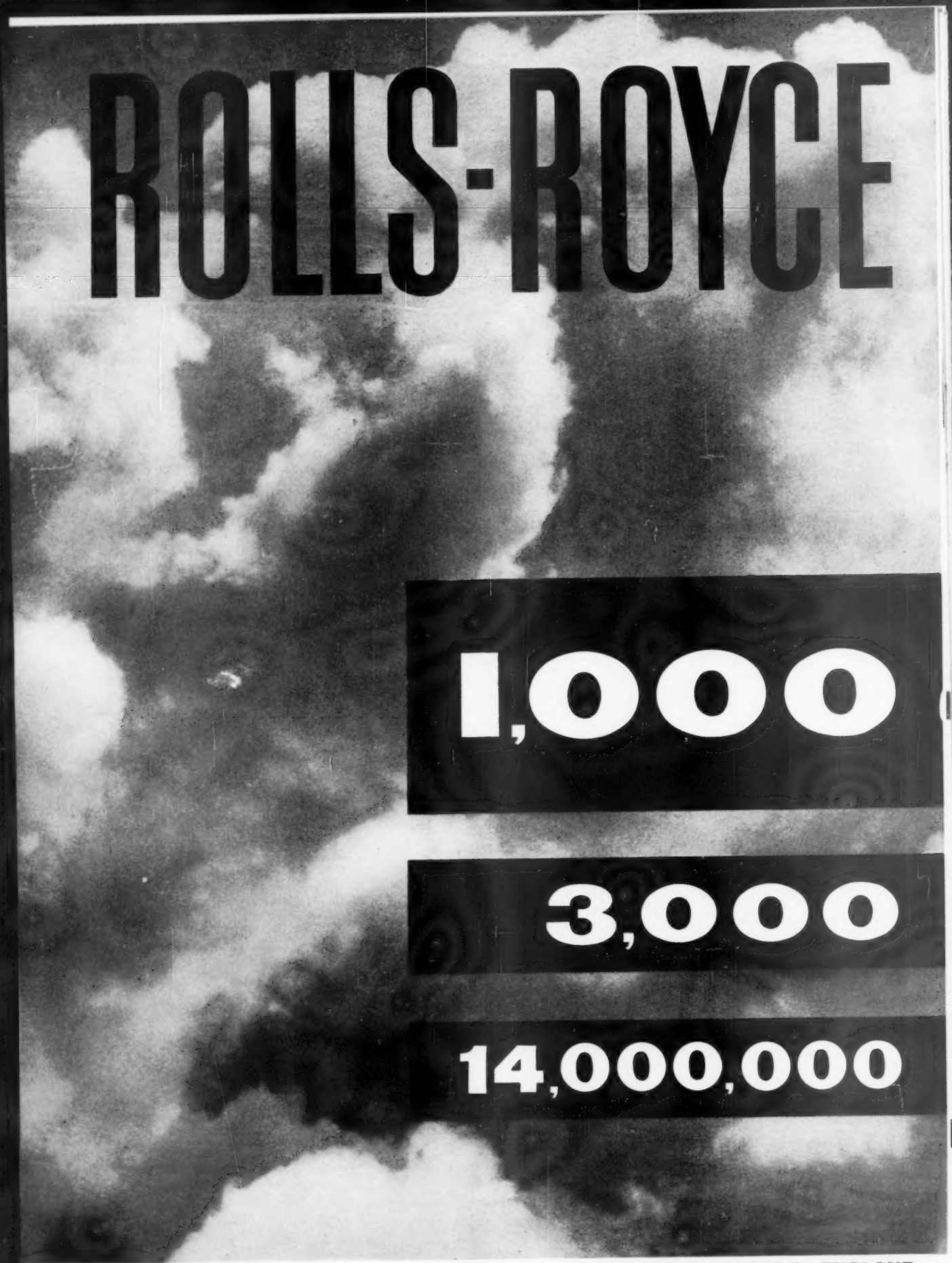
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"This dropping zone was barely a backyard

. . . attached to a little ring of huts perched right on top of a hill—completely surrounded by a bowl of 10,000 ft. mountains. A sharp turn had to be made immediately on passing the dropping zone to climb up out of the bowl. It felt as though we were brushing the treetops on the mountainside as we flew round in a 45°-bank turn at 110 knots for a second run. However, the Herald coped . . . ."

So ran the pilot's report of a supply-drop by Dart Herald in the Naga Hills of Assam. Such challenging tests have demonstrated the aircraft's versatility and strength during its see-it-in-action proving flights of over 175,000 miles around the world to 55 widely-differing countries.

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HANDLEY PAGE RADLETT LONDON READING

Talking Shop at Seattle—II

News of projected developments of the Boeing transport family is contained in this concluding article by GORDON SWANBOROUGH

IT had been my hope, when arranging to visit Boeing's Transport Division, that plans for the production of the short-to-medium-haul 727 would have become firm by the time I reached Seattle. This, unfortunately, was not to be, and Boeing was consequently reluctant to "talk numbers," at least for publication, on this project. Both Maynard Pennell, Transport Division's director of engineering, and Don W. Finlay, his chief of preliminary design, did confirm the general details of the design, which is for an aeroplane of about 120,000 lb. gross weight, to carry 68-107 passengers, with three engines in the rear fuselage.

It is tailored to fit U.S. airports such as La Guardia, where the instrument runway is less than 5,000 ft. long, and Chicago Midway, where the 6,000-ft. runway is complicated by obstacles on the approach and take-off paths. It has the same fuselage cross-section as the 720 from the floor level up. A full-size metal mock-up has been built and is being used for "three-dimensional designing" by engineers to establish such things as pipe and cable runs.

I asked Mr. Pennell about the background of the 727 design and where it fitted into the general transport picture. By way of answering, he recalled that the original 367-80 prototype had started out as a 165,000-lb. aeroplane in the general bracket of a DC-6 replacement. During its development, however, the design grew to the point of being a DC-7 and -7C replacement and then grew still further to the 707 Intercontinental as it is today.

Boeing then went back to the original concept in the design of the 720; but the advent of turbofans has led to the growth of this aeroplane, to the point where it is now a "pretty good North Atlantic aeroplane." U.S. domestic airlines—United and Eastern specifically—felt that the Boeing 720 was too big and too expensive for use as a DC-6 replacement, but wanted something a little larger, and with better field performance, than such aeroplanes as the Caravelle and D.H. 121 Series I already on offer.

A three-engined layout was chosen for the 727 because "we were not satisfied with two and didn't want four." Pennell was specific on this point: "If we were to build a four-engined aeroplane we would have no hesitation in using pods—there is no question about this." I asked about the advantages of a "clean" wing. Pennell said he got "a different answer every week" on this point, some indicating an overall advantage and some not. On the 727, Boeing would achieve a C_L max. similar to that on a straight-winged aeroplane, and hoped to do so without blown flaps.

Boeing originally favoured Rolls-Royce engines for the 727, but in recent months it has become clear that the U.S. domestic airlines most interested in the project would insist on Pratt & Whitney turbofans, and engine availability has become, as a result, the controlling factor in the time scale for 727 development. Much of the basic structural design work is complete and Boeing is "all ready to pull the plug" as soon as Eastern and United can complete their financing. Each is expected to order 40.

Finlay confirmed that the rear-engined layout was dictated on the 727 by the decision to use three engines ("the only whole number between two and four") rather than by a desire to obtain a "clean wing." All manner of engine arrangements were studied, including the use of two wing pods one side and one the other. Such an arrangement is quite feasible engineering-wise, but was rejected by Boeing because it was felt the public would not accept it and on an issue of this kind, said Finlay, "your competition, helped by the Press, can crucify you."

We went on to talk of the programme of product improvements in hand on the 707 series. These are concerned primarily with improving the wing lift, and enable Boeing to claim that they can match Vickers' "clean-wing" lift coefficients by 1962. As we showed in our issue for Aug. 26 (in an article entitled "Rear-engined Arithmetic") the VC-10 family is expected to

The heading picture shows the 6½-year-old -80 prototype as it is today. Close study will reveal the full-span, slotted leading-edge flaps, the ducts from the inboard engines for flap blowing and the new plain fillet flaps at the wing root. For comparison, the flaps on the Boeing 720 are shown on the right.

A recent picture of the final assembly shop at Renton, with the last B.O.A.C. 707-436 in the foreground (since rolled-out) and 720s for United and American beyond. Each aircraft takes approximately 44 days to move round the six positions on this line.

have lift coefficients of the order of 2.32, compared with the 1.88 of the Boeing 707-420 in service today. Confirming that this latter figure was correct, Finlay said that the 720, which has the most sophisticated high-lift system developed by Boeing so far, now has a C_L max. of just over 2.0.

In 1962, the Boeing 320B will have a coefficient of 2.3, and in 1963-64 the Boeing 520B will develop 2.4. These lift coefficients, Finlay pointed out, are largely determined by the amount of fuel which has to be carried in the wing, which controls the volume available for leading and trailing edge flaps, and their mechanism and supporting structure.

Since the 707 was first put into production, improvements have already been made by the introduction of leading-edge flaps. These comprise, on the -120 and -220, a single segment immediately inboard of the outer engine pylons and, on the -320 and -420, two segments, inboard of the outer and inner pylons. On the 720, a further leading-edge flap has been added on the wing sections outboard of the pylons. This same flap arrangement is used on the -120B conversions to turbofan power, and on the third -320 for South African Airways, which has a special hot-weather, high-altitude problem on its routes.

Further improvement of the leading edge involves a complete redesign of the flaps to cover the whole span from tip to root, and to arrange their operation in such a way as to produce a slotted effect, not obtained at present. These are at present being flown on the -80 prototype, which I saw in the flight test area at Boeing Field.

Refinement of the trailing-edge flaps to date has included the introduction of letter-box slots immediately aft of the hinges, to improve the airflow. A further stage of development is to introduce a plain flap, instead of a split flap, on the wing-root fillet, in the area where the undercarriage complicates the flap behaviour. On the -80, which has this new plain flap, blown flaps are also being investigated; the general Boeing philosophy towards boundary layer control is to use it to correct airflow only over the portions of the flaps which "misbehave."

Future Models

The Boeing aeroplane for 1962, taking advantage of these developments (but without blown flaps) is the 707-320B with turbofan engines. Dimensionally the same as the present -320 and -420, this variant would use 18,000-lb.s.t. Pratt & Whitney JT3D-3 turbofans to obtain a 900-mile range improvement. With a space-limited payload of 41,000 lb.—141 passengers plus baggage plus residual freight at 10 lb./cu. ft.—the 320B has a 4,600-naut. mile range with normal airline reserves, and will cruise at up to 520 knots (Mach 0.87) at 25,000 ft. at 280,000 lb. weight.

The use of this high cruising speed, at max. cruising engine thrust, results in a 1,800-mile range penalty compared with the long-range cruise procedure, but will allow the -320B to "control the speed race" on routes such as the North Atlantic where the maximum range is not required. From New York, this aeroplane will carry a payload of 37,000 lb. or more to any of the principal ports of entry into Europe; it will carry 29,000 lb. from London to San Francisco non-stop, 35,000 lb. in the reverse direction, and 37,000 lb. each way between New York and Moscow.

For 1963 or 1964, the Boeing 520B is offered, with 21,000-lb.s.t. P. & W. JT3D-5A turbofans and a space-limited payload of 49,000 lb. This version has a fuselage stretch of 140 inches, gross weight of about 350,000 lb., and an inner wing leading-edge glove, similar to that on the 720, to provide more fuel capacity. Blown flaps would be used to obtain the target lift coefficient of 2.4. Capable of flying round the World in three stages, the -520B would carry a 38,000-lb payload from London to San Francisco and 44,000 lb. in the reverse direction.

As a civil freighter, Boeing suggest a version of the -320B, which can have a swing tail although Finlay said this is "difficult to justify for purely civil operation." The swing tail increases the basic operating weight by about a ton, which has to come out of the payload and therefore increases the operating costs. With a mechanized loading system, the -320B freighter would have a payload of 80,000-90,000 lb. at 10-11 lb./cu. ft. loaded density and with a gross weight of 315,000 lb.

Boeing pure freighter studies are made under the model designation 735, usually suffixed by a number equivalent to that of the 707 series to indicate size and powerplant—e.g., 735-120B, 735-320B. Boeing also has in the mock-up stage a completely new military freighter designed for MATS to the SR182 requirement (see our issue for Oct. 14). This is a turbofan-powered aeroplane with a high wing and a knuckled undercarriage to allow the fuselage to be brought right down to ground level for loading.

Another matter for design improvement with which Boeing is at present much concerned is that of non-divergent Dutch roll. This is apparent as very slight directional instability rather than Dutch roll in its normally understood, divergent, sense, and is a consequence of the natural motion of the control system. The extent of this instability varies from time to time, from aircraft to aircraft and from altitude to altitude, and its correction calls for extremely close tolerances in the control system. Rudder responses of the order of ¼-inch are needed, which in turn call for control-wire movements measured in thousandths, to be made in the face of the elasticity and inertia of the system itself.

In addition to the highly utilized—and now much modified—prototype -80 (which may be flown next year with an engine in the tail as part of 727 development) I saw in the flight test area both the turbofan-engined Boeings—the -120B and the 720B—at present undergoing F.A.A. flight testing. According to "Dix" Loesch, chief of flight operations, more than 230 hours have now been flown on the two turbofan prototypes, both of which are destined eventually for American Airlines.

As I recorded last week, the improvement in take-off performance attributable to the increased power of the turbofan engines and the extra leading-edge flaps of the -720-type wing has not been fully matched by a reduction in approach speeds. Consequently, the field length required by the "B" models, to comply with SR422B (1.65 times the distance to stop from 50 ft.) is more than the field length required for take-off.

The design of the turbofan nacelles is a thing of which Boeing is especially proud. These were extensively illustrated in our issue for Sept. 23, when we showed how the reversers for both the fan air and the main exhaust stream are normally faired over and exposed only for operation; and how increased

air-mass flow for take-off power is obtained through spring-loaded doors round the outer nose of the nacelle. The external shape of the nacelle is aerodynamically excellent, and was established with the help of a new Boeing technique in which the behaviour of a thin sheet of water flowing round a model of the component is studied.

No silencers are fitted on the turbofan engines, but the noise of the front fan has been found to be excessive, especially during the approach. To overcome this, Pratt & Whitney have designed and are to introduce a "hush kit" for the JT3D. This modification reduces the number of inlet-guide vanes, doubles the number of first-stage stator vanes and respaces the stator blades.

Production at Renton

A tour of the production facilities at any large American manufacturing company cannot fail to be an education for the visitor from Europe. My guide for this vital piece of indoctrination was Mike Gladych, who flew with the R.A.F. in Nos. 302 and 303 (Polish) Squadrons during the War, as well as with the Polish, French and U.S. Air Forces, and is now in Transport Division's public relations department. He took me to see the final assembly lines, where production of both the 707-720 and the KC-135 is now past the peak, but is still tremendously impressive.

Standing right on the edge of Lake Washington, the assembly building is 903 ft. wide and 501 ft. long. Renton has, in addition, a manufacturing building measuring 602 ft. by 545 ft. and the total covered floor area at Transport Division is 3,560,000 sq. ft. In the assembly shed, there is a common military and civil line on which wings and wing stubs are joined to form a single whole-span unit. Beyond this operation, the military and civil lines diverge into separate wing-body joining lines for the 707 and KC-135, and then separate final assembly shops.

There are six positions on the commercial final assembly line at the present time, compared with 11 at the peak. Earlier this year, in fact, 707s were occupying space on the military final assembly line too. All the aircraft on the line at the time of my visit were 720s, but no distinction is made, for assembly purposes, between the various commercial transport types. Production was at the rate of one every four working days (week-ends are not worked), compared with a peak of just over nine a month. Lead time for an airline reordering a 707 or 720 is now about 14 months; a new customer would have to wait a little longer for delivery.

Adjacent to the commercial line, the KC-135 final assembly area has four positions and produces seven aircraft a month, which is just below half the peak rate of 15 a month. A total of 492 KC-135s have been ordered and I saw the 433rd on the line. Whereas 707s are delivered to Boeing Field in Seattle on their first flight, the KC-135s go to the U.S.A.F. base at Moses Lake for acceptance.

At approximately $1.7m., less engines and Government-supplied equipment, the KC-135 has the lowest cost per lb. weight of any American military production aeroplane. Boeing is now trying to sell to MATS and the U.S. Army the so-called C-135H (an unofficial designation) which has a double-bubble fuselage with rear loading ramp.

Employment in the three Boeing divisions in the State of Washington (Transport, Aero-Space and Industrial Products—see the first part of this article, published last week) totals about 65,000, which is not so very far short of the peak War-time figure. In addition, Wichita Division employs 21,500 and Vertol Division 2,700. Despite this high level of employment, Boeing still uses sub-contractors on a quite extensive scale—more than 2,000, in fact, in the KC-135 programme alone. Major suppliers to the two programmes, military and civil, include Aeronca (wing stub); Northrop (outboard wings and aft body); Ryan and Rohr (aft mid-body); Cleveland Pneumatic and Bendix (main landing gear); Menasco (nose landing gear); Rohr (engines, struts, tailplane); and Twin Coach (fin and rudder).

To date, Boeing has written off $160m. on development and production costs in connection with the 707 including the $16m. spent on producing the -80 prototype. This total, up to the third quarter of 1960, can be regarded as the amount by which total development, production and manufacturing costs exceed the proceeds from the sale of about 160 aeroplanes. No break-even quantity is quoted by the company, but Boeing is now making a profit on each 707 it sells—and the present total of 258 on order and delivered is certainly not the limit of sales for this impressive family of aeroplanes.

THE BOEING 707 FAMILY—AN AIDE MEMOIRE

Model	Fuselage length	Wing details			Powerplant	Max. T.-o. weight	Max. fuel capacity	Customer information
		Span	Gross area	Flap Arrangement				
	ft. in.	ft. in.	sq. ft.			lb.	U.S. gal.	
707-120	138 10	130 10	2,433	L.e. segments inboard of outer pods.	11,200 lb. JT3C-6 (13,500 lb. with water).	247,000	13,478	-121 Pan American (6). First flt. 20.12.57. -123 American (25). First flt. 5.10.58. -124 Continental (5). First flt. 25.3.59. -131 T.W.A. (15). First flt. 3.12.58. -139 Western (2). First flt. 20.3.60.
707-138	128 10	130 10	2,433	L.e. segments inboard of outer pods.	11,200 lb. JT3C-6 (13,500 lb. with water).	247,000	17,398	-138A Qantas (7). First flt. 20.3.59.
707-120B	138 10	130 10	2,510	Inner wing glove and three l.e. flap segments on each wing.	17,000 lb. s.t. JT3D-1 (water to maintain this power "hot and high").	258,000	17,398	-123B American (1+24 converted -123). First flt. 22.6.60.
707-138B	128 10	130 10	2,510	Inner wing glove and three l.e. flap segments on each wing.	17,000 lb. s.t. JT3D-1 (water to maintain this power "hot and high").	258,000	17,398	-138B Qantas (3+7 converted -138A). For 1961 delivery.
707-220	138 10	130 10	2,433	L.e. segments inboard of outer pods.	15,800 lb. JT4A-3 (no water).	247,000	13,478	-227 Braniff (5). First flt. 11.6.59.
707-320	145 6	142 5	2,892	L.e. segments inboard of all pods. (Third for S.A.A. has additional segments on outer wing.)	15,800 lb. JT4A-3 or 16,800 lb. JT4A-9 or 17,500 lb. JT4A-11 (no water).	311,000	23,815	-321 Pan American (26). First flt. 15.2.59. -328 Air France (20). First flt. 11.9.59. -329 Sabena (5). First flt. 3.11.59. -331 T.W.A. (12). -344 South African (3). First flt. 25.5.60.
707-320B	145 6	142 5	2,892	Revised l.e. full-span slotted flaps. New plain fillet flap.	18,000 lb. JT3D-3 (water to maintain this power "hot and high").	315,000	23,815	Offered for 1962 delivery and available as -320 conversion.
707-420	145 6	142 5	2,892	L.e. segments inboard of all pods.	18,000 lb. Conway 508 (RCo. 12).	311,000	23,815	-430 Lufthansa (5). First flt. 18.12.59. -436 B.O.A.C. (15). First flt. 19.5.59. -437 Air India (4). First flt. 14.1.60. -441 Varig (2). First flt. 2.4.60. -458 El Al (2). For delivery in 1961.
707-520B	157 2	142 5	—	Inner wing structural glove for fuel. Full-span slotted leading edge flaps. Selected flap blowing on trailing edge.	21,000 lb. JT3D-5A.	350,000	—	Offered for delivery in 1963-64. Conway RCo.42/2 engines alternatively available.
707-720	130 6	130 10	2,510	Inner wing glove and three l.e. flap segments on each wing.	12,000 lb. JT3C-7 or JT3C-12 (no water).	225,000*	16,016*	-022 United (29). First flt. 23.11.59. -023 American (10). JT3C-7 engines. -025 Eastern (15). JT3C-12 engines. -027 Braniff (3). JT3C-7 engines. -027 F.A.A. (1). For training and airways checking. -048 Irish Airlines (3). First flt. 14.10.60.
707-720B	130 6	130 10	2,510	Inner wing glove and three l.e. flap segments on each wing.	17,000 lb. JT3D-1.	229,000	14,790	-023B American (15+10 converted -023). First flt. 6.10.60. -030B Lufthansa (8). For 1961 delivery. -047B Western (4). For 1961 delivery. -059B Avianca (2). Delivery in 1961. -060B Ethiopian (2).
735-320B	145 6	142 5	2,892	Full-span slotted l.e. flaps.	18,000 lb. JT3D-3.	315,000	—	Representative all-cargo project; many permutations studied.

* Boeing 720 is available with five different fuel configurations and weights ranging from 185,000 lb. to 225,000 lb.

The Multi-mission Mach 2 Mirage

By John Fricker

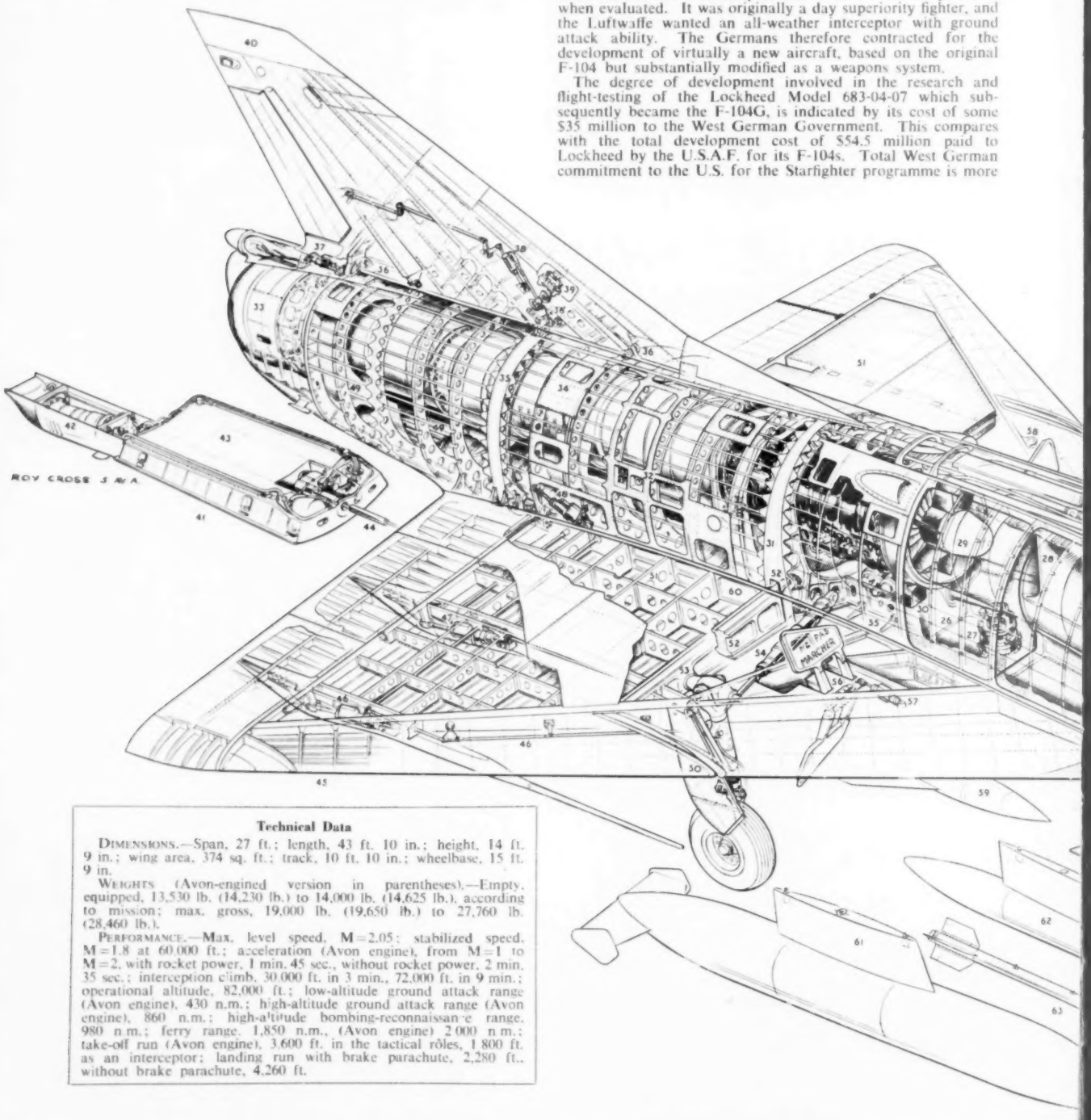
SHOPPING for military aircraft, for the smaller countries of the World, is a long and involved process. It might seem that all that is wanted is a design to fit the required specification, but in practice there are many other factors to be explored.

The cost of modern weapons systems is such that purchasing contracts are the subject of even more intense international competition than in the past. It is axiomatic that exportable military types must first be ordered by their national air forces, before being released for sale abroad. But export orders are then prone to a "snowball" effect; once one foreign contract is confirmed further sales tend to follow rapidly.

In the fighter field, this effect has been dramatically demonstrated by the success of the Lockheed F-104 Starfighter, which after extensive two-year evaluation and negotiations, was adopted by the West German Air Force, and subsequently for NATO in Europe, the R.C.A.F. and Japan. Much of this success is due to the fact that it was the first M=2 fighter to become internationally available, and is the only aircraft to have held simultaneously the World records for speed and altitude. Ironically, it was used only in limited numbers by the U.S.A.F. for whom it is no longer being produced.

As it happened, the F-104 was selected by the Germans more on the basis of its potential than from its capabilities when evaluated. It was originally a day superiority fighter, and the Luftwaffe wanted an all-weather interceptor with ground attack ability. The Germans therefore contracted for the development of virtually a new aircraft, based on the original F-104 but substantially modified as a weapons system.

The degree of development involved in the research and flight-testing of the Lockheed Model 683-04-07 which subsequently became the F-104G, is indicated by its cost of some $35 million to the West German Government. This compares with the total development cost of $54.5 million paid to Lockheed by the U.S.A.F. for its F-104s. Total West German commitment to the U.S. for the Starfighter programme is more

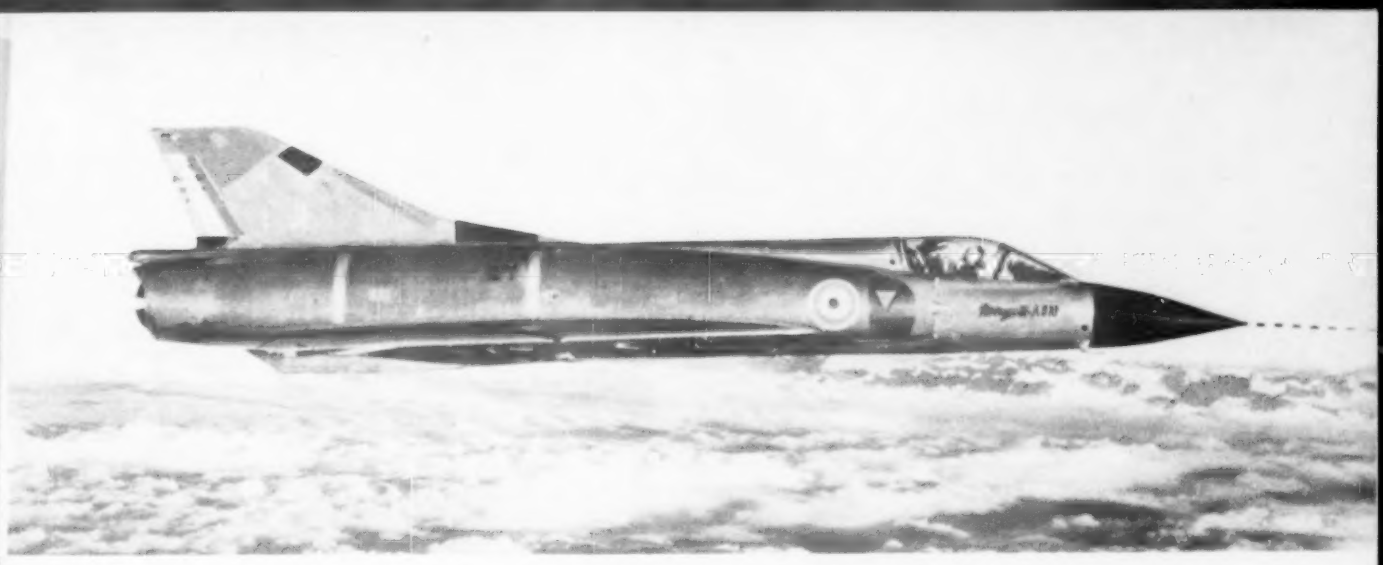


Technical Data

DIMENSIONS.—Span, 27 ft.; length, 43 ft. 10 in.; height, 14 ft. 9 in.; wing area, 374 sq. ft.; track, 10 ft. 10 in.; wheelbase, 15 ft. 9 in.

WEIGHTS (Avon-engined version in parentheses).—Empty, equipped, 13,530 lb. (14,230 lb.) to 14,000 lb. (14,625 lb.), according to mission; max. gross, 19,000 lb. (19,650 lb.) to 27,760 lb. (28,460 lb.).

PERFORMANCE.—Max. level speed, M=2.05; stabilized speed, M=1.8 at 60,000 ft.; acceleration (Avon engine), from M=1 to M=2, with rocket power, 1 min. 45 sec., without rocket power, 2 min. 35 sec.; interception climb, 30,000 ft. in 3 min., 72,000 ft. in 9 min.; operational altitude, 82,000 ft.; low-altitude ground attack range (Avon engine), 430 n.m.; high-altitude ground attack range (Avon engine), 860 n.m.; high-altitude bombing-reconnaissance range, 980 n.m.; ferry range, 1,850 n.m., (Avon engine) 2,000 n.m.; take-off run (Avon engine), 3,600 ft. in the tactical rôles, 1,800 ft. as an interceptor; landing run with brake parachute, 2,280 ft., without brake parachute, 4,260 ft.



Seen here without its rocket boost pack, the tenth and last pre-series Mirage IIIA (Atar 9) is identical to the production IIIC.

than $200 million, which gives some idea of the sums involved in re-equipment.

In some respects, this West German example is not entirely representative, since much of the enormous sum involved was paid to bring the resurgent national aircraft industry up to date with the production of advanced airframes and engines. On the other hand, to the costs of the aircraft programme must be added the expenses of extending the Luftwaffe's airfields to meet the demands of the highly loaded Starfighter.

This procurement background on a widely used current aircraft gives some idea of the problems involved in the search for new equipment. Currently shopping in the international fighter market are Australia, Israel and Switzerland, the main contenders being the F-104, and the Mirage III of Générale Aéronautique Marcel Dassault. There is also the excellent SAAB Draken, which is something of a dark horse, except in Switzerland, where the choice has narrowed between it or the Mirage.

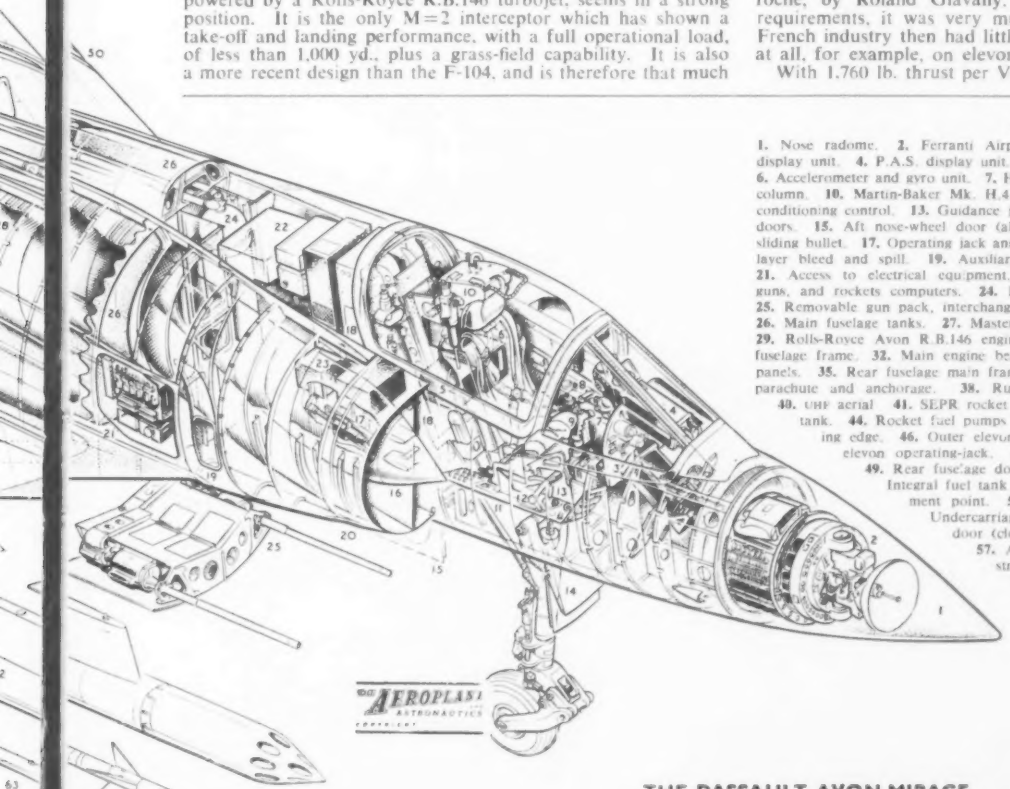
On purely a technical basis, the "export" Mirage III, powered by a Rolls-Royce R.B.146 turbojet, seems in a strong position. It is the only M=2 interceptor which has shown a take-off and landing performance, with a full operational load, of less than 1,000 yd., plus a grass-field capability. It is also a more recent design than the F-104, and is therefore that much further from obsolescence, the F-104 having originated from design studies in 1950, when Korea showed the need for more advanced American military aircraft.

Korea also provided a stimulus for the Dassault design team, which had been responsible for virtually all the post-War French jet fighters. These comprised 350 Ouragan, 145 Mystère II, 425 Mystère IVA and 180 Super Mystère B.2 types, or well over 1,000 in all, including export sales to India and Israel. These were followed in 1952 by two lightweight projects for a highly supersonic interceptor and a strike fighter.

The latter subsequently became the Etendard, and the interceptor project was the Dassault entry for a French design competition in 1954. With two Vipers, the resultant MD.550 Mirage I materialized as a very small (24 ft. span) and thin (5% t/c) delta-wing design, with provision for rocket boosting, to compete with the more radical S.O. Trident and the S.E. Durandal.

Built at the St. Cloud (Paris) experimental plant of Dassault, the Mirage I was first flown on Jne. 25, 1955, at Melun-Villaroche, by Roland Glavany. Although designed to military requirements, it was very much a research vehicle, since the French industry then had little supersonic experience and none at all, for example, on elevon controls.

With 1,760 lb. thrust per Viper, the Mirage I had insufficient



KEY

1. Nose radome. **2.** Ferranti Airpass Mk. IIC radar scanner. **3.** Search display unit. **4.** P.A.S. display unit. **5.** Radar controller, bombing computer. **6.** Accelerometer and gyro unit. **7.** Hand control unit. **8.** Throttle. **9.** Control column. **10.** Martin-Baker Mk. H.4 ejection-seat. **11.** Side console. **12.** Air conditioning control. **13.** Guidance joystick for missiles. **14.** Twin nose-wheel doors. **15.** Aft nose-wheel door (also Doppler aerial). **16.** Air intake with sliding bullet. **17.** Operating jack and rails for automatic bullet. **18.** Boundary layer bleed and spill. **19.** Auxiliary slow-speed air intake. **20.** Gun port. **21.** Access to electrical equipment. **22.** Radio/radar bay. **23.** Air data, guns, and rockets computers. **24.** Recuperator fuel tank for inverted flight. **25.** Removable gun pack, interchangeable with rocket fuel tank or computer. **26.** Main fuselage tanks. **27.** Master gyro (Atar-Mirage). **28.** Air ducts join. **29.** Rolls-Royce Avon R.B.146 engine. **30.** Engine gearbox unit. **31.** Main fuselage frame. **32.** Main engine bearer. **33.** Afterburner. **34.** Engine access panels. **35.** Rear fuselage main frame. **36.** Fin attachment points. **37.** Tail parachute and anchorage. **38.** Rudder operating-jack. **39.** Yaw damper. **40.** UHF aerial. **41.** SEPR rocket pack. **42.** Rocket tube. **43.** Rocket fuel tank. **44.** Rocket fuel pumps drive-shaft. **45.** Conical camber on leading edge. **46.** Outer elevon operating-jack and linkage. **47.** Middle elevon operating-jack. **48.** Inner elevon/trimmer operating-jack. **49.** Rear fuselage double wall skinning. **50.** Wing notch. **51.** Integral fuel tank volume. **52.** Main wing spar and attachment point. **53.** Main undercarriage pivot point. **54.** Undercarriage operating-jack. **55.** Inner undercarriage door (closes when gear is down). **56.** Air-brakes. **57.** Air-brakes operating-jack. **58.** Wing stores strong point. **59.** Nord A.A.20 missile. **60.** Strong fuel-proof root-rib. **61.** Underwing drop-tank. **62.** J.L.100 rocket/fuel pod. **63.** Sidewinder AAM.

THE DASSAULT AVON-MIRAGE

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Mach 2 Mirage . . . .

power for more than M=1.15 in a shallow dive, but with a Dassault afterburning system, M=1.2 was achieved by June. 13, 1956. With the addition of the 3,307 lb. thrust SEPR 66 rocket, a new swept fin, and increased wing area Gerard Muselli was able to fly at M=1.3 on the level at 40,000 ft. in December, 1956, but this proved the limit of this combination. Greater power was envisaged with the twin-Gabizo Mirage II, which also had an increase in wing area, from the original 290.6 sq. ft., but this was passed over in favour of the even more potent Mirage III.

With the bigger wing (312.1 sq. ft.) of the interim project, the Mirage III-001 was designed as an interceptor with a SNECMA Atar G1, which developed 8,818 lb. thrust with afterburning, and was housed in a newly area-ruled 42-ft. fuselage. Although similar, including its straight-cut cheek intakes, to the Mirage I, the Mk. III prototype was virtually a new design, weighing 15,212 lb. instead of 11,177 lb. Glavany made the first flight at Melun on Nov. 17, 1956.

On its tenth flight, on Jan. 30, 1957, the Mirage III attained M=1.52 at 40,000 ft., with full reheat power, and then dived gently to 36,000 ft. to an indicated speed of M=1.6. A speed of M=1.8 was later achieved, with the aid of the SEPR rocket, although this was mainly intended to improve altitude rather than airspeed. The latter was limited largely by the non-variable intakes.

These were therefore modified, beginning with the forward extension of the boundary-layer bleed intake. A more sophisticated arrangement was evidently necessary, and a half-cone similar to that in the F-104 was then incorporated in each intake, which was extended forward alongside the cockpit. But unlike the American aircraft, the Mirage was given movable half-cones, sliding fore and aft at faster and slower speeds to focus the resultant shock wave in the optimum position on the intake lip for pressure recovery, and to exclude the unstable flow or "buzz" from the duct.

The half-cones were initially controlled manually by the pilot, and showed an immediate improvement, the intakes being about 3 in. outboard of the fuselage to clear the boundary layer, which was bled internally for secondary pressurizing and cooling. Boundary-layer bleed was still unsatisfactory, and the inner flank of the intake duct was then extended forward, but further trials evolved the definitive arrangement of the straight inner profile.

Flight-trials with the half-cones had been resumed by the Mirage III-001 prototype on Apr. 17, 1958, and had shown an effective increase of thrust of up to almost 20% at high supersonic speeds. The maximum level speed rose from M=1.52 to M=1.65, with reheat power of the 9,700 lb. Atar G.2 then fitted. Among the pilots who flew the modified prototype Mirage III-001 was Major Walter Krupinski, a wartime Luftwaffe fighter ace, who was favourably impressed by its then-limited performance and handling.

Improving the Versatility

Mirage emphasis at that time, however, even within Dassault, was purely on interception and the Luftwaffe was seeking a multi-purpose aircraft. Although its aerodynamic development was well advanced, the Mirage was then at an early stage as a weapons system, and its radar and fire-control electronics were even further behind. Dassault's own projected equipment was cancelled, and the selected C.S.F. Cyrano installation was still under basic development.

Despite its more demanding airfield requirements, the Germans therefore turned to the F-104, but they had at least demonstrated the need for multi-mission capability by the Mirage. This was subsequently confirmed by the French Air Ministry when initially authorizing a preproduction batch of 10 Mirage IIIAs, for interception and ground-attack duties. These were allotted specific development tasks, for various systems and flight aspects, and there was virtually an entirely new engine to test in the Atar 9.

Produced for flight at high Mach numbers, the Atar 9 had additional compressor and turbine stages, and produced 9,700 lb.s.t. at 8,400 r.p.m. dry, and 13,225 lb. thrust with afterburning, for a weight of 2,755 lb. It was accompanied by an increase in fuselage length from 42 to 46.58 ft., while the span grew from 24.86 to just under 27 ft. The area increased from 312 to 366 sq. ft., and maintained the wing loading at a very moderate 48 lb./sq. ft., despite the gross weight rising to 17,581.8 lb. As a matter of interest, the F-104A wing loading at a similar loaded weight was almost three times this figure, at 142 lb./sq. ft.

Dragwise, the increase in area was offset by a decrease in thickness/chord ratio from the original 5% to a taper from 4.5 to 3.5%. The revised nosewheel-door arrangement introduced latterly on the Mirage III-001 was adopted as standard,

Evaluation of the Mirage IIIA prototype was conducted in June by an R.A.A.F. and Dept. of Supply mission comprising (left to right), Mr. I. B. Fleming, Div. of Aircraft and G.W., D.o.S., Air Marshal Sir F. Scherger, C.A.S., Gp. Capt. D. R. Cuming, Mr. L. F. Bott, Asst. Sec., Finance, D.o.S., and Wg. Cdr. Hodges, seen here with M. Serge Dassault.

but some redesign of the cockpit was effected. The 001 prototype had a knife-edge front screen and a "Gothic arch" canopy frame, but the IIIA reverted to a conventional three-piece windscreen and hood.

As in all the prototypes, a British Martin-Baker Mk. 4 lightweight automatic ejection seat was installed in the Mirage IIIA-01 which made its initial flight on May 12, 1958. It then carried Dassault Aïda radar, of the type fitted to the Etendard.

Intensive flight trials with the Mirage IIIA-01 did not begin until September, 1958, when its handling was initially explored up to 50,000 ft., without the revised SEPR 84 rocket. On Oct. 24, 1958, from Istres, Glavany became the first French pilot to achieve M=2 in a French aircraft, after about 1½ months of flight testing. This performance was attained without rocket power, and another pre-series IIIA later set up a 100 km. closed-circuit record on Jne. 9, 1959, of 1,109 m.p.h.

The first prototype Mirage IIIA was rapidly followed by nine other preproduction examples, in which the entire performance and handling spectrum was rapidly covered. Remarkably few changes were required, amounting to an increase of dorsal fin area, and extension of the wing leading-edge into a very pronounced conical camber. This resulted in a prominent downward curve to the outer elevon sections, and an increase in wing area to 374 sq. ft.

Other modifications included a cut-forward flare to the extreme rear fuselage, revealing the turbojet afterburner eyelids, and the final intakes, enclosing the boundary-layer bleed to the fuselage. First preproduction aircraft to reach definitive standards, including installation of the plastic radome for the Cyrano interception equipment and its balancing ventral fin was the Mirage IIIA-05, later designated the IIIC, which aroused much interest at the 1959 Paris Salon.

Also displayed there, although statically, was the prototype Mirage IIIB two-seat trainer, resulting from a fuselage extension of some 20 in., and relocation of the equipment for a second cockpit, with another Martin-Baker ejection seat, in tandem. The two 30 mm. DEFA cannon remained below the intake ducts, and the Mirage IIIB retains all the operational potential of the single-seaters.

It is principally intended for the familiarization of pilots with all-weather interception at very high altitudes, the Mirage having a zoom ceiling of about 100,000 ft., and a stabilized operational altitude at M=1.8 of 75,000 ft., with the SEPR rocket. First flight of the Mirage IIIB-001 was on Oct. 20, 1959, in the hands of M. Bigand at Réau-Villaroche. At 17,460 lb. all-up, the Mirage IIIB was slightly lighter than the early single-seat aircraft, and with its improved fineness ratio, fractionally better in performance.

Production interceptor version of the Mirage is the IIIC, for the initial French Air Ministry order for 400 aircraft. The first 100 of these are likely to be interceptors, followed by the second batch (for which credits are also available) comprising 50 for tactical reconnaissance, 26 IIIB trainers, and 24 IIID or IIIE ground-attack variants plus a further 100 in 1963 and in 1964.

For tactical-bombing duties, the four-bolt attachment of the nose radar permits the rapid installation of another electronics unit or navigational system, and in place of the gun and rocket packs are additional fuel tanks, bringing the

internal capacity to 636 Imp. gal. Two drop tanks of up to 374 gal. per side are carried beneath the wings, and a 992 lb. tactical atomic bomb slung beneath the fuselage. The IIID variant has been more or less dropped, in favour of an improved Mirage with similar capabilities.

A photographic pod containing five cameras is an alternative ventral load, or in the Mirage IIIE, the nose radar may be replaced by a tactical reconnaissance installation. Alternative underwing stores on each side include Sidewinder or Firestreak A.A.M.s; 93, 176, 286 or 374 gal. drop tanks with provision for flight-refuelling probe; a 1,000 lb. bomb; a Napalm tank, and a Dassault JL 100 or 200 rocket launcher/fuel tank with 18 or 36 Brandt SNEB 22 projectiles of 68mm. calibre.

The two under-fuselage pylons have a total capacity of 2,000 lb. for similar loads, plus provision for MATRA R.511-530 A.A.M.s or Nord 5103-5401 A.S.M.s. The Mirage III can fire semi-active radar missiles or infra-red homing weapons during the same sortie. For ground-attack duties, a gun pack with two 30mm. DEFA 5-52 cannon and 200-250 rounds may be carried in place of the interception computer in the lower mid-fuselage.

Rolls-Royce Power

For export, a prototype Mirage III is being built, powered by a Rolls-Royce Avon Mk. 67 or R.B.146, which is similar to some Lightning powerplants. The R.B.146 delivers 12,500 lb. static thrust and 16,000 lb. with reheat, compared with the 9,370/13,200 lb. of the Atar 9B in the Mirage IIIC. With an assumed intake efficiency of 85%, the British engine will maintain 12,600 lb. thrust at M=2 and 36,000 ft. Installation of the R.B.146 involves virtually no modification, and this engine has a considerably better specific fuel consumption than the Atar.

The engine compartment remains unchanged, the turbojets being almost identical in diameter except for the Avon's slimmer afterburner. The R.B.146 slides forward on the same two lateral rails for installation as the Atar, after removal of the double-skinned rear fuselage.

Rear fuselage doors give additional access, although the engine continues to be reached principally through the fuselage mainwheel wells for servicing. No change in intake configuration is needed despite the 3% increase in mass flow of the Avon, except for the alteration of the shock-cone supersonic movement ratio. Weight increase with the Avon is about 640 lb., which causes a slight aft C.G. movement. Time for an engine change is quoted by Dassault as two hours.

As the other component of the intercepter powerplant, the SEPR 841 rocket pack is completely self-contained, with an integral 69 gal. tank for the nitric acid propellent, and a six-bolt attachment to the rear-fuselage recess.

A telescopic spline-shaft picks-up via a pneumatic clutch with the separate turbojet accessory gearbox to drive the rocket pack pumps, which feed TX Furaline from a 32-gal. tank in the gun bay and the acid propellent to the combustion chamber. Rocket operation is controlled by a three-position switch in the cockpit which permits almost instantaneous selection of half or full thrust (1,654 or 3,374 lb. at sea level) and off again as required. At full power, which reaches 3,704 lb. at 52,459 ft., there is a continuous output endurance of 80 sec., which is naturally doubled at half-thrust.

The specific consumption of the SEPR 841, which is manufactured by Hispano-Suiza, is 0.0048 lb./lb./sec. at sea-level, and 0.00435 at 52,500 ft. Through the widespread use of light-alloy parts, stainless steel being limited to the turbine and some parts of the oxidizer circuit, the unit has a total dry weight of only 452 lb., including pressurization equipment and accessories. From the maintenance viewpoint, it is cleared for 50 flights between major checks. It is jettisonable for safety in a belly landing, and when not required, is replaced by a finned fuel tank of up to 130 Imp. gal. capacity.

Weapons Electronics

In addition to the French Cyrano I or II radar system, for navigation, contour and ground mapping, interception, weapon guidance and air/ground delivery, the Mirage is designed to accept any of the international electronic equipment of a comparable nature, such as our own Ferranti Airpass IIC, the U.S. Autonetics Super Nasarr or the Hughes Taran. Airpass II was developed as a P.V. by Ferranti from the Mk. I interception and pilot attack sight system in the Lightning, to European requirements for a multi-mission aircraft.

The result was a self-contained unit including computers for the radar, fire and bombing systems. In the interception mode, its function is search and automatic tracking; lead collision attack with radar semi-active missiles and rockets under all-weather conditions; lead pursuit with automatic weapons; and pure pursuit with infra-red missiles. Its navigation capabilities, including Doppler, cover the requirements for all-weather bombing at very low altitudes, and for ground attack it provides air-ground ranging for A.S.M.s, dive and dive-toss bombing, and computations for visual or blind long-throw or over-the-shoulder delivery of nuclear weapons.

In the Mirage III there is an opening bay of a generous size immediately behind the cockpit with a similar clamshell "canopy" and easy accessibility for the stowage of electronic equipment and the individual computers of the navigational and attack equipment. For interception, the gun bay is also occupied by an attack computer.

In the cockpit, in addition to the normal pilot attack sight (P.A.S.) incorporating a collimated presentation, there is a search display radar scope beneath the instrument panel. During ground scan, a map picture is produced on the radar scope, which can also present navigational information.

With the navigation computer, the unit can identify the target and provide steering signals to it for presentation on the P.A.S. display. In the terrain clearance mode, provision is made for following a chosen course in bearing whilst flying very low on instruments, via steering signals once more on the sight.

For interception, the radar, which is stabilized in pitch and roll, locks-on once a target is located and seen on the search display, and begins to track. Once locked-on, a computer in the radar unit automatically works out the best approach course for attack with guns, rockets or missiles, giving range, closing speed and aircraft attitude.

On completion of the approach, the P.A.S. ensures correct weapons aim, even in non-visual conditions, or the attack may be completed visually, since the sight and windscreen coincide. A warning lamp tells when to break off the attack to avoid collision with the target.

Design and Constructional Features

Basic requirements guiding the design and development of the Mirage III were simplicity of structure, for low manufacturing and maintenance costs; short and rough-field take-off and landing characteristics, for low ground-installation cost; and versatility, to provide a M=2 fighter at 60,000 ft., and an atomic bomber with an 800-n.m. delivery.

The first two requirements, of course, conflicted strongly with the third, but Dassault have managed to combine all three. One of the first things the Australian evaluation team did was to check the pressure of the Mirage's fat broad-tread tyres, which are fuselage-stowed and inflated to only 100-128 lb./sq. in., compared with the normal figure of some 260 lb./sq. in. for the thin-tyred F-104.

With the aid of its big wheels and tyres, the Mirage IIIA prototype made mild history in June this year by operating from a rough, dusty and pebbly field, as an interceptor, at

The seventh preproduction Mirage IIIA shows off its new cruciform tail parachute when landing with elevon sections fully raised.

Top, the two-seat Mirage IIIB at Melun before its first flight and subsequent installation of its nose radar. Above, the first production Mirage IIIC, due in French service early next year.

Mach 2 Mirage . . . .

a gross weight of 18,500 lb., with a Nord 5103 missile beneath the fuselage. In these unfavourable conditions, Dassault pilot J. Coureau took off in 800 m. and landed in less than 600 m. with parachute and mainwheel braking.

Dassault selected the 60° delta wing, in preference to the thin straight wing, for its low t/c ratio and yet mechanically thick section; its large wing area for a short span, and low wing-loading, avoiding the necessity for high-lift devices; and to eliminate the tailplane, with advantages in weight, manufacture and maintenance.

The 60° sweep with 2½° anhedral to prevent Dutch roll permits very fast acceleration to M=2, and the short span, in conjunction with the almost Spitfire-like wing-loading, results in exceptionally good manœuvrability. The stiff Mirage wing has one very robust tapered main-spar, which picks up on two closely tied massive forged frames forming the fuselage strong point, and the wing planform is outlined by the two auxiliary spars for the nose torsion box and control surface attachments.

Internal structure of the wing is a fairly conventional rib and sub-spar lattice, capped above and below by a thick tapering skin milled with integral stiffeners. These large skin sections are hand-finished to polish and round off the corners to minimize the danger of fatigue cracks. Channels are cut beneath the stiffeners to permit the passage of fuel, since the rear portion of the wing volume is used as integral tankage, with a capacity of 117 Imp. gal. per side.

Cut-out panels in the wing are kept to the minimum, for the small air-brake segments above and below the inner forward-chord and for the inward-retracting mainwheel legs, pivoting on the main-spar. External mounting is also used for the Dassault electro-hydraulic servo-jacks for the elevons, which are divided into three sections on each mainplane, to cope with wing bending loads. The jacks, with their fully duplicated and irreversible systems, are housed in four fairings beneath the 31% outer wing, the inner control surfaces, which are used mainly for trimming purposes, having a separate servo unit in the centre fuselage. Wing "saw-cuts" act as vortex generators and separate the flow on inner and outer panels for subsonic stability.

Fuselage of the Mirage is built in seven segments, each fabricated in halves, before being joined to the next. In the forward part of the engine bay, flanking the intake ducts, are two 55- and two 60-gal. flexible bag tanks, and a 17½-gal. recuperator tank for inverted flight which bring the total normal internal fuel of the Mirage to 480 Imp. gal. Except for the use of massive one-piece forged main frames for mainspar attachment, and heavier metal thicknesses, fuselage construction is orthodox, with the usual formers and stringers.

Another heavy fuselage frame just aft of the rear-spar attachment provides a pick-up for the forged mainspar of the fin, which is built up in a similar way to the wing, except for its riveted skin. Forward of the fin spar is the servo unit for the tiny inset rudder, together with the yaw damper and directional trim unit.

Fuselage and the wing panels of the Mirage III are built by Dassault at Argenteuil, Paris, while the wings are assembled by Nord Aviation at Meaulte. The fin is made by Dassault at Talence, Bordeaux, where final assembly of airframe and engine is completed at Merignac airfield.

The first production Mirage flew, as scheduled, within just over two years of the prototype IIIA's initial flight, and production is now building up to the rate of nine aircraft per month. In all, some 30,000 people are employed on Mirage III production, about 5,500 being on the Dassault payroll.

Mirage in the Air

Dassault has a small team of test pilots at Bordeaux-Merignac to handle production Mirages as they come off the line—their entire former output of more than 1,000 jets was test-flown by one man, M. Georges Brian, between 1946 and 1959. Chief test pilot is now Gerard Muselli, assisted by MM. Coureau, Rastell and Tixador. The first Mirage IIIC has already gone to Bretigny for Service acceptance; the second to Centre d'Essais Militaire European, Monte-de-Marsan; and third to Cazeaux for further firing trials. The Mirage has fired its cannon at speeds up to M=1.6 and 50,000 ft., while it has released air-to-air missiles at up to M=1.8.

From the pilot's point of view, flying the Mirage at speeds of more than M=2, which more than 95 pilots (including Madame Auriol) of American, Australian, British, Dutch, French, Israeli, Swiss nationalities have done in some 2,000 flights, including 100-plus with rocket boost, presents only one limitation—that of avoiding excessive compressor inlet temperatures because of kinetic heating. This is expressed very simply by the fact that the Atar currently has to be inspected after completing four hours' continuous operation at M=2, which represents many flights for an interceptor, whereas its life is only six minutes at M=2.2.

This will be extended in later aircraft with the Atar 9C, and its steel compressor blades, instead of the earlier 9B, but in the meantime a warning light operates when inlet temperature limits (125° C.) are approached. The inlet shock-cones also have temperature sensing incorporated with their Mach-linkage for automatic movement. Because of the intake temperature limitations, the Mirage's rocket motor, when fitted, is used only during the climb, from about 38,000 ft. upward, to maintain M=1.8 to about 70,000 ft.

A partial-pressure suit of French manufacture is used by Mirage pilots, together with an American K-1 type P.P. helmet. A *g*-suit is incorporated in the flying clothing, and white leather overalls with air ventilation are being tried to reduce cockpit temperatures. The pressurized pilot's compartment is surprisingly roomy and comfortable, and the control layout conforms to NATO standards. The instrument panel uses miniaturized dials with a simple layout.

The Mirage has been described by a relatively inexperienced pilot as easier to fly than a Hunter, and with its very low wing-loading it certainly appears viceless. On take-off, in after-burner power, its non-steerable nosewheel is lifted off at 110 knots, and unstick is in the region of 155 knots, at a slightly more nose-up attitude than normal. The stick is eased slightly forward after rotating to the unstick attitude, as usual with most delta types.

Undercarriage retraction limit is normally 220 knots, although the gear is cleared to 250 knots for extension, and to 270 knots when fully down. A tailless delta cannot compensate for large trim changes, which have therefore been designed to a minimum at all times. The small air brakes follow this pattern, and may be extended at any speed up to the maximum. Their efficiency, however, falls off fairly rapidly.

The sophisticated performance of the Mirage has been achieved by the simplest means. For example, the controls have only a simple spring feel, matching displacement directly with force, and the degree of auto-stabilization is small. The latter is essential for weapons release, but the Mirage has been flown to 70,000 ft. and M=2 in all regimes with both the yaw and elevon dampers disengaged. The most noticeable effect during high-altitude handling is increase in the frequency of oscillations.

In low-speed handling, the Mirage has been taken down so far to about 125 knots, at which the stick was not fully back on its aft stop, and the aircraft was unstalled, although sinking very rapidly. There was little airframe buffet, and full control was available. No spinning trials have yet been completed, although wind-tunnel tests have shown good characteristics in two-turn spins.

For landing, an incidence of about 15° is normally used, and touch-down is at about 145 knots. A tail parachute is used on every landing, and in place of the original ribbon design, a new canopy of cruciform pattern has been developed for production Mirage IIICs. This permits rather higher deployment speeds at, say, 20 knots above the normal approach on finals, up to about 190 knots to give virtually a constant landing run.

In a typical interception rôle, operating with the SEPR 841 rocket at 19,700 lb. all-up, including 480 Imp. gal. of fuel,

1,320 lb. of nitric acid and AAMs, the Mirage IIIC might climb to 30,000 ft. at M=0.9, accelerate to M=1.55 to light its rocket, continue to M=1.8 and reach 60,000 ft. in a total time from take-off of 6 min. 10 sec. Its interception radius would be 140 n.m. With an Avon engine, its time to 60,000 ft. would be reduced to 5.1 min. Small (93.5 Imp. gal.) underwing fuel tanks, jettisoned at 36,000 ft., can increase the supersonic radius of action.

At the zoom altitudes which the Mirage is capable of reaching, there is insufficent airflow through the engine to maintain afterburner combustion, which emphasizes the importance of the rocket installation for interception. Rocket thrust may also be used to reduce the turn radius of the Mirage, to outmanœuvre other aircraft. Even without this aid, some remarkable figures are achieved, such as five nautical miles at 40,000 ft. and M=1.7 and two nautical miles at the same height and M=1.

As a low- and medium-altitude interceptor, without the rocket pack, and at an all-up weight of some 19,000 lb., the Mirage IIIC, with 570 Imp. gal. of fuel, could climb at M=0.9 to 35,000 ft., accelerate to M=1.8 and continue to 50,000 ft. in less than seven minutes, over an interception radius of 150 n.m. It would then have sufficient fuel for a subsonic return to base and the completion of two GCAs.

The Avon-Mirage should climb to 50,000 ft. in 6 min. 5 sec., without rocket assistance.

There are many other combinations of sortie profiles, but a representative long-range strike with a 1,000-lb. nuclear bomb plus two 30-mm. cannon, and 180-gal. underwing tanks could involve climbing at M=0.9 to 40,000 ft., cruising at that speed for 550 n.m. before descent, a 10-minute low-level attack and a subsonic high-altitude return after a total mission time of about 2 hr. 10 min. Take-off weight would then be more than 26,000 lb., and landing weight about 15,000 lb., assuming 880 lb. of internal fuel.

That, then, is the Mirage; easy to build (it can be produced with unified threads), easy to fly, easy to operate. Its basic cost per aircraft, in round figures, of some £275,000 does not have to be boosted by airfield extension, and it is an aircraft with a good deal of development potential ahead of it.

Suitability of the Mirage for Australian requirements may be judged from a Parliamentary discussion, earlier this year, by the Air Minister, Mr. Osborne, on R.A.A.F. re-equipment. "It has," he said, "particular complexities which arise from our geography, from the great distances to be covered both in our strategic area and within Australia itself. In addition, there are comparatively few airfields in Australia and S.E. Asia capable of withstanding sustained operations by modern military aircraft. Their high take-off and landing speeds, their weight and their small high-pressure tyres can inflict unacceptable damage on any airfield pavements not specially constructed to withstand them. . . ."

. . ." The time is approaching when my department should be able to give firm advice to the Government on the choice of a new fighter. Much work has been done by the Air Staff in analysing the technical data of many fighters. . . . When we choose an aircraft we will be committed to it for a long time. Again, our geography and the scarcity and cost of modern military airfields come into the picture. A fighter which will suit the NATO powers, or Canada . . . will not necessarily suit us.

"The fighter chosen . . . must also be versatile enough to give ground support to the Army as well as high performance in its primary air defence rôle. In 1957, the Government was contemplating the selection of the F-104, but postponed a decision as the aircraft was too specialized for our particular needs."

Mr. Osborne mentioned that Air Vice-Marshal V. E. Hancock, A.O.C. Operational Command, accompanied by two experienced specialist R.A.A.F. officers and Mr. I. B. Fleming of the Department of Supply, were then to visit the U.K., France and the U.S. to investigate a few aircraft. These were understood to be the Mirage, F-104 and the Northrop N.156.

The question of local construction was raised by Mr. Bird, who said that the Australian Government had given no indication where the new fighters would be built. He thought that if an order for about 100 fighters were given to local industry to be built at the rate of four or five a month, they could be produced at a reasonable price. It might not be as cheap as the overseas figure, but it would be near enough to make production in Australia more or less an economical proposition.

The Commonwealth Aircraft Corporation factory at Fisherman's Bend, Victoria, which had built 111 Avon-Sabres, is well equipped to build modern fighters, using milled and tapered skins, and other advanced techniques, although its original labour force of 5,000 for the F-86 programme had since been reduced to about 2,700. R.B. 146 production would also present few new problems to the Commonwealth Aircraft Corpn., which built a large number of Rolls-Royce Avons under licence for both the Sabres and Canberras manufactured in Australia.

An Air Racing Occasion

H.R.H. The Duke of Edinburgh was the principal guest last week at the R.Ae.C. dinner to the 1960 Air Racing Champion and King's Cup Winner, Sqn. Ldr. J. de M. Severne, A.F.C. Unlike other occasions of this nature, however, Prince Philip was attending in his own right as entrant of the winning Turbulent, and, as Lord Brabazon reminded the diners, an R.Ae.C. member.

"Brab" was at the top of his sparkling form when introducing the guests, who also included Alderman Mrs. Pearl Hyde, M.B.E., chairman of Coventry Airport Committee, and the Rt. Hon. Peter Thorneycroft, M.P., Minister of Aviation.

Col. R. L. Preston caused much amusement by reminding his listeners that trophies were awarded to the winning pilots and cash to the entrants, but the King's Cup was such an honour that no cash was attached to it. But this year was notable for marking the first air racing victory by a Royal entrant.

He said that the club had now found a satisfactory racing formula, comprising a cross-country event, followed by a closed-circuit contest. Next year, there would be a London-Cardiff race, probably starting from Panshanger, on Jne. 2-3, plus eliminating races for the King's Cup and the Coventry events on Jly. 13-15.

Nineteen hundred and sixty-one would also be the sixtieth anniversary of the R.Ae.C., and a big business and air touring competition was planned. This would probably be at Kidlington on Jly. 27-29. It was also hoped that foreign aircraft would become eligible next year for the King's Cup.

After receiving his trophies from Prince Philip, Sqn. Ldr. Severne outlined the history of the Tiger Club Turbulent and its tuning for the race. They had gone for the fastest configuration, and, after seeing his handicap, he was confident that he could win if he could finish. Norman Jones, however, put all his money on Clive Francis, who was second man home!

ROYAL WINNERS.—Many well-known aviation personalities are recognizable in this group with the Duke of Edinburgh after dining Sqn. Ldr. John Severne (on the left of H.R.H.) at the Royal Aero Club on Nov. 23. On the Duke's right is Lord Brabazon of Tara and fifth from the right is the Minister of Aviation.

The Fighting Services

Live Firestreak Training

LAST month Sea Vixen FAW.1s of No. 890 Squadron completed the Navy's first full-scale training firing of Firestreak AAMs. Undertaken from the carrier H.M.S. "Hermes," then operating in the Irish Sea, the exercise provided the Service with its first opportunity to test the full operational routine of preparing, loading and firing the weapon. Over 80% successful, the firings were made against Meteor target drones.

Last National Service Intake

THE final organized R.A.F. National Service entry passed through the reception unit at Cardington last week.

Since July, 1939, when the Service received its first men under the Military Training Act, some 1,640,000 have entered the R.A.F. from the National Service field and of these 600,000 converted to regular service. During the past 15 years, 6,000 National Servicemen have been entered for aircrew training and in 1951 five special flying training schools for pilots and navigators were opened in connection with the Korean War.

All National Service and regular recruits have been initiated into the Service through Cardington since the summer of 1953, before which the majority entered through Padgate. The Cardington reception unit is to move to Bridgnorth, where reception and initial training will be combined.

Guest of Honour

AIR VICE-MARSHAL E. W. S. JACKLIN, Chief of the Rhodesian Air Staff, recently made an eight-day visit to the R.A.F. in this country and Germany.

Arriving at London Airport on Sunday, Nov. 20, he was met by Air Vice-Marshal J. Grandy, Assistant Chief of the Air Staff (Operations), and started his tour by visits to the Deputy Chief of the Defence Staff and the Minister of Defence the next morning. Guest of honour at a luncheon at Fighter Command Headquarters, at which the C.A.S., Air Chief Marshal Sir Thomas Pike, presented him with a cup subscribed for by the eight home Commands, Air Vice-Marshal Jacklin also saw the Secretary of State for Air the same day.

On the Tuesday he visited R.A.F. Coltishall and saw the Javelin FAW.9s and Lightning F.1s of Nos. 23 and 74 Squadrons. The next day he met R.R.A.F. apprentices under training at No. 1 School of Technical Training at Halton and visited Headquarters, Bomber Command. This was followed by a visit to R.A.F. Cottesmore to see the Victors of No. 15 Squadron and the R.A.F. College, Cranwell, on the Thursday.

Last Friday morning, Air Vice-Marshal Jacklin travelled by Transport Command Comet to R.A.F. Wildenrath where he was met by the C.-in-C., R.A.F. Germany, Air Marshal Sir Humphrey Edwardes Jones. Remaining in Germany for three days, he was to be the guest of honour at a dinner given by the Air Council on Monday, Nov. 28.

R.A.F. Appointments

THE following are among recent Royal Air Force appointments:

Air Ministry: Wg. Cdr. G. S. Fry, D.F.C., to the Department of the Chief of the Air Staff.

Bomber Command: Wg. Cdr. W. McQ. Pratt to Headquarters for equipment duties.

Fighter Command: Wg. Cdr. G. P. Elliott, D.F.C., to R.A.F. Bawdsey as Wing Commander, Operations.

Transport Command: Sqn. Ldr. T. M. Potter to Headquarters as Command Catering Officer, with acting rank of Wg. Cdr.

Maintenance Command: Sqn. Ldr. R. H. C. Powling to No. 27 Maintenance Unit, Shawbury, to command, with acting rank of Wg. Cdr.

R.A.F. Germany: Gp. Capt. S. E. D. Mills, C.B.E., to Headquarters for staff duties; Wg. Cdr. G. L. Smith to Headquarters as Deputy Command Provost Marshal.

Middle East Air Force: Wg. Off. B. B. Barker, W.R.A.F., to Headquarters for Organization duties and as Command W.R.A.F. Officer.

Far East Air Force: Wg. Cdr. J. C. Cox to Headquarters for flight safety duties; Wg. Cdr. A. P. Morgan, D.F.C., to No. 367 Signals Unit to command; Wg. Cdr. N. Storer to R.A.F. Changi as Senior Secretarial Officer; Wg. Cdr. F. G. Daw, D.F.C., A.F.C., to Headquarters for Organization duties.

British Forces Arabian Peninsula: Gp. Capt. A. K. Furse, O.B.E., D.F.C., and Wg. Cdr. M. D. Logan, both to Headquarters, the former as Deputy Air Officer in charge of Administration, the latter as Command Signals Officer

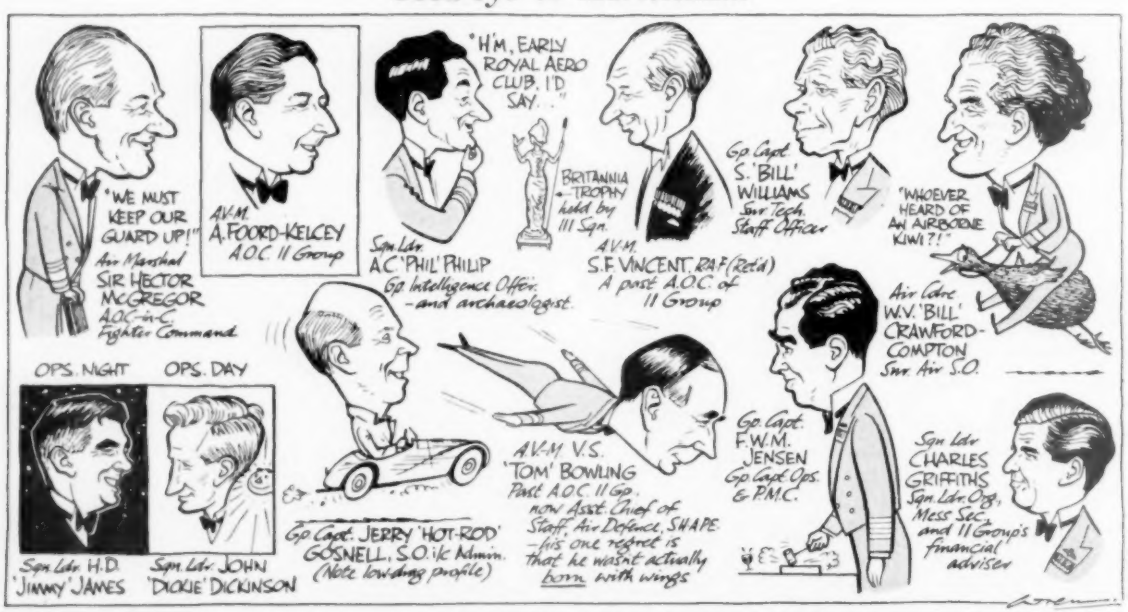
Other Appointments: Wg. Cdr. P. G. H. Matthews, D.F.C., to Prague as Air Attaché, with acting rank of Gp. Capt.; Sqn. Ldr. E. G. A. Hart to Malta to command the Communications Centre.

More Service News

Australian Training.—The first group of four Australian Army helicopter pilots to be trained by the Royal Australian Navy have completed their conversion course at Howra Naval Air Station. The second course started on Nov. 21.

Point Cook.—Gp. Capt. K. R. J. Parsons, D.S.O., D.F.C., A.F.C., R.A.A.F., who has been attending the Imperial Defence College in London, has been appointed Commandant of the R.A.A.F. Academy at Point Cook, with the acting rank of Air Cdre.

Good-bye to Martlesham


"WE MUST KEEP OUR GUARD UP!"
Air Marshal SIR HECTOR McGREGOR A.O.C.-in-C. Fighter Command
A.V.M. A. FOORD-KELCEY A.O.C. 11 Group
"H'M, EARLY ROYAL AERO CLUB, I'D SAY..."
Sqn. Ldr. A.C. 'PHIL' PHILIP Gp. Intelligence Officer -and archaeologist
BRITANNIA TROPHY held by 111 Sqn.
A.V.M. S.F. VINCENT, RAF (Retd) A post A.O.C. of 11 Group
Gp. Capt. S. 'BILL' WILLIAMS Snr. Tech. Staff Officer
"WHOEVER HEARD OF AN AIRBORNE KIWI?!"
Air Cdre. W.V. 'BILL' CRAWFORD-COMPTON Snr. Air S.O.
OPS. NIGHT
OPS. DAY
Sqn. Ldr. H.D. 'JIMMY' JAMES
Sqn. Ldr. JOHN 'DICKIE' DICKINSON
Gp. Capt. JERRY 'HOT-ROD' GOSNELL, S.O. i/c Admin. (Note lowering profile)
A.V.M. V.S. 'TOM' BOWLING Post A.O.C. 11 Gp., now Asst. Chief of Staff, Air Defence, SHAPE -his one regret is that he wasn't actually born with wings
Gp. Capt. F.W.M. JENSEN Gp. Capt. Ops. & P.M.C.
Sqn. Ldr. CHARLES GRIFFITHS Sqn. Ldr. Org., Mess Sec., and 11 Group's financial adviser

FEWER AND FEWER.—Wren was present at the dinner held at the Martlesham Heath H.Q. of No. 11 Group, Fighter Command, on Nov. 18 to mark the imminent closure of the famous airfield as well as the temporary disbandment of No. 11 Group. The ultimate result of this "streamlining" (officialese for "reduction") will be seen early in 1961, when the Group will be re-formed in the place of No. 13 Group, which will be permanently disbanded.

Jet Provost

Powered by one Bristol Siddeley Viper ASV 8 or ASV 11

Now in regular service at
Royal Air Force
Flying Training Schools.
Also in service with the
Royal Ceylon Air Force.

Entering service with the
Royal Air Force in 1961,
the Jet Provost T.Mk. 4
takes off in 1030 ft
lands in 1415 ft
climbs to 30,000 ft
in 13.3 minutes
has a max. level speed of
357 kt and a max.
range of 600 n.m.

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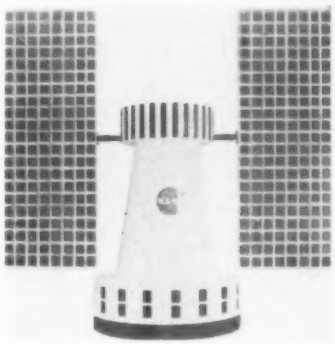
A New Weather Satellite

A SECOND Tiros satellite, capable of photographing and mapping weather 3,600 miles north and south of the Equator, took its place in orbit on Nov. 23. It was launched by the same type of three-stage Delta rocket that sent the balloon satellite Echo I into a near-circular orbit some three months ago.

The orbit of Tiros II is also remarkably circular. Its apogee is given as 435 miles, perigee 415 miles and period 98 minutes. This fine achievement is directly attributable to the BTL radio guidance system and the special flight controller which programmes the rocket's trajectory after cut-off of second-stage thrust. A cutaway drawing and description of the Delta and its guidance system was in our issue for Sept. 23 last.

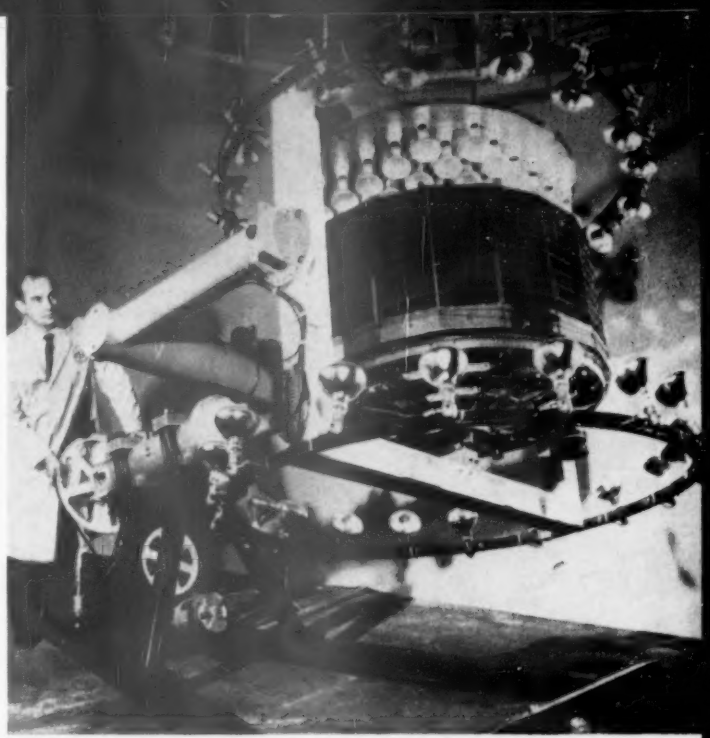
Like its forerunner, launched on Apr. 1, Tiros II carries two miniature TV cameras designed to photograph cloud cover. One is a narrow-angle, high-definition camera which worked well from the beginning: the other is a wide-angle camera which has been giving trouble, possibly, it is suggested, because of drain on the chemical batteries. In addition, there are seven infra-red sensors for the purpose of measuring radiation in various spectral bands reflected from Earth.



Mock-up of the projected operational weather satellite, Nimbus, with which NASA expects to follow the Tiros research satellites in 1962. Weighing 600-700 lb., it will have a stabilization system to keep TV cameras and scan-type radiation sensors pointed Earthward at all times.

With this more comprehensive equipment, it is hoped to obtain data which will assist in forecasting tornadoes, hurricanes and other troublesome storm conditions as well as more conventional forms of weather. Chief of the U.S. Weather Bureau, Dr. F. W. Reichelderfer, has gone so far as to say that had there been an operational system of weather satellites orbiting the Earth at the time of the recent storms in East Pakistan, thousands of lives could have been saved. An operational system of four Nimbus weather satellites is planned for 1962-63.

Meanwhile, Tiros II is looked upon as an essential research tool in achieving this goal. Shaped like a pill-box and weighing 280 lb., the satellite is covered on top and sides by 9,200 solar cells. Picture data is stored on magnetic tape for time-lapse transmission on command from ground stations, or it can be transmitted directly from the satellite.



Tiros II is here seen in a special test rig that checks the operation of the satellite's stabilization system. Lights permit testing of the thousands of solar cells mounted on top and sides of the 19 in. high, 42 in. diameter satellite.

Five small solid rockets are mounted on the satellite's base-plate so that its spin-rate—and hence stability—can be adjusted, if necessary, by radio command. Stability of Tiros II is also bound up with the influence of the Earth's magnetic field.

This subject was touched upon by Dr. T. Keith Glennan, the NASA Administrator, during a conference on magnetism and magnetic materials in New York last month. "The spin of a satellite with large conducting areas is rapidly damped by motional induction," he said. "The Earth's field will also exert a torque on a satellite possessing a significant magnetic moment from magnetic parts or current loops. These factors can be used to advantage with proper design. For example, it was discovered that magnetic torques on Tiros I maintained the proper orientation of the satellite for an extended time and thus additional pictures were obtained."

In Tiros II, these magnetic effects have been taken fully into account in a new stabilization system, which, as our picture shows, has been put to exhaustive test in the laboratory.

Although the orbit of Tiros II carries the satellite over south Russia and south China, NASA has emphasized that its pictures are not sufficiently definitive to be of reconnaissance value.—K.W.G.

Calibration of field of view and focus of the two TV cameras installed in Tiros II. The lens of the wide-angle camera protrudes from the base-plate of the satellite, upper right. Pictures from this camera were proving troublesome a few days after the launching, possibly due to drain on the chemical batteries. (Left) Preparing for a test of the weather satellite's stabilization system with the test rig and satellite mounted inside a spherical "cage" designed to produce magnetic fields resembling those it will meet in orbit.

Letter Via Satellite

FIRST successful transmission of a "Speed Mail" letter, using the Echo satellite as a relay station, was announced in New York on Nov. 11. The technique introduces another commercial opportunity for satellite communications.

The letter was scanned by a facsimile transmitter in Washington, D.C., and the signals from the transmitter were then sent by wire to the Naval Research Laboratories at Stump Neck, Maryland. Thence they were transmitted by microwave to the Echo satellite orbiting nearly 1,000 miles above the Earth.

Bounced off the reflecting surface of the satellite, the signals were picked up by the sensitive tracking antenna of the Bell Telephone Company at Holmdel, New Jersey. A wire-line carried the signals from Holmdel to the Postmaster in Newark where they were converted to their original form by a facsimile receiver.

With existing techniques, the system is capable of transmitting up to 50 letters simultaneously in a period of three minutes. Satellite links planned for the near future by the military services and U.S. private industry, it is reported, will permit the transmission of six standard one-page letters, maps or pictures every second.

Solar Effects on Echo I

THOSE who may have read the remarks by Maj.-Gen. Ostrander (THE AEROPLANE AND ASTRONAUTICS, Nov. 18, 1960, pp. 691-693) on the subject of solar-sailing, may be interested in the following information concerning the orbit of the 100 ft. dia. balloon-satellite, Echo I, which itself has been affected by "solar wind." The pressure of solar radiation, amounting to only 1/50th oz., is steadily pushing the polyester balloon nearer to the Earth at its closest approach (perigee) at the rate of 3½ miles every day and modifying its near-circular orbit into an ellipse.

When the satellite was launched into orbit on Aug. 12, its perigee was 932 miles. Measurements taken in October showed this had fallen to about 817 miles. At its present rate of descent, it should burn-up in the atmosphere within 12 months.

It will be interesting to see if NASA—which seems intent on investigating every kind of space-vehicle—will now be sufficiently encouraged to begin a research programme into solar-sail propulsion.

Navigation for Astronauts

"A FIELD-DAY for mathematicians" best describes the symposium on "Navigation and the Early Exploration of the Moon" organized jointly in London by the British Interplanetary Society and the Institute of Navigation on Nov. 18. Apart from equations, however, there was much of general astronautical interest.

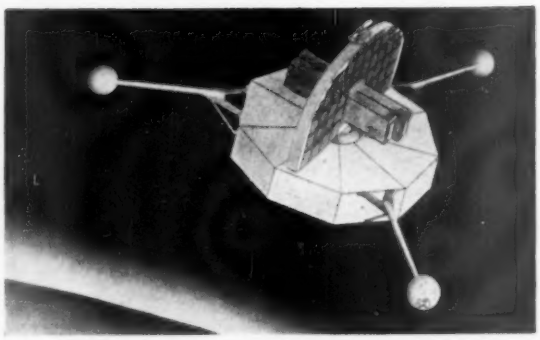
The morning session brought Prof. Samuel Herrick to the platform on a flying visit to London between classes at the University of California. His lecture, "The Demands of Nearby Parabolic Lunar Trajectories on Differential Correction and Perturbation Theory," introduced simplified equations governing the motion of a body in the Earth-Moon system. Next, Mr. A. R. Maxwell Noton, University of Nottingham, considered "Guidance of Space Vehicles by Radio Measurements and Command." Future U.S. space-probes, he said, would place great reliance on three 85-ft. dia. directional antennae. One was at Goldstone, Cal.; another was under construction at Woomera, Australia, and a third would be erected in South Africa. These stations would supply angular data and two-way Doppler measurements.

Mr. D. J. Cashmore (English Electric Aviation, Ltd.) began the afternoon session with a paper on "The Rôle of Inertial Equipment in Lunar Flights." In this, he outlined the principles of an inertial stabilized platform, monitored by star telescopes, which would be capable of operating with and without radio contact with Earth-stations. The proposed astro-navigator would embody a light-weight digital computer and cater for initial, mid-course, and terminal guidance.

Another subject tackled by Mr. Cashmore concerned the so-called neutral points where the gravitational fields of Earth and Moon are in equilibrium. He thought it might be possible to place a combined optical and radio-beacon at these points as an aid to space-navigation. The beacon itself might take the form of a spin-rotating "corner reflector" with alternate panels coloured black and white to produce a scintillating effect. Around the beacon's equator would be a ring of solar cells to power a direction-finding transmitter embodied in a central spherical pack.

Concluding the formal proceedings, Mr. P. A. E. Stewart (Hawker Siddeley Aviation, Ltd.) gave an interesting non-mathematical paper on the subject of "Surface Navigation on the Moon." Difficulties, he said, arise from the lack of an appreciable magnetic field, ruling out direction-finding by compass; the small lunar diameter of only 2,160 miles which limits line-of-sight communication (an object has to be 1,000 ft. high to be seen by a 6-ft. man at a distance of 22 miles); and the lack of a useful ionosphere to reflect radio signals.

The speaker suggested that lunar navigation/communication satellites and stellar navigation would help overcome these deficiencies. Short-distance communication over difficult terrain might make use of "earth currents," or electromagnetic waves, transmitted through the ground. Mobile exploratory vehicles would require an inertial navigation system monitored at intervals of say three hours by astronomical sightings or information obtained via the navigation satellites.—K.W.G.



SUN SCANNER.—Among the new generation satellites being developed by NASA is this 350-lb. Orbiting Solar Observatory. Its operation was described by Mr. Morton J. Stoller, assistant director for NASA Satellite and Sounding Rocket Programs, when he visited this country in October ("The Aeroplane and Astronautics," Oct. 14, 1960, pp. 540-541).

Reliability in Space Communications

IT may be 15 to 20 years before a reliable communication satellite suitable for commercial use is placed in orbit, according to Maj.-Gen. L. de M. Thuillier, who led the fact-finding team which recently returned to this country from the United States. Important factors, he said, were the reliability of its equipment and the problem of keeping it in orbit. If anything went wrong with the satellite, there was no way of repairing it in space.

The British party, which visited industrial companies and U.S. Government agencies concerned with communications satellites, included representatives of the G.P.O., the Minister for Science, the Ministry of Aviation, the Admiralty and the Ministry of Defence. In view of the fact that military considerations were involved, the full report of the team's findings is unlikely to be made public. It is expected, however, that this document—which will be considered by various Government departments—will discuss the relative merits of the different communication satellites now under development in the United States, including that by the American Telephone and Telegraph Company, and military projects such as Courier and Advent.

Although the recent A.T. and T. proposal to launch an experimental polar-orbiting relay satellite on a private industry basis, "within a year," has been regarded by many observers as a blow to British hopes for developing an active communication satellite using the proposed Blue Streak launcher, the remarks by Maj.-Gen. Thuillier suggests that ample room for development exists on both sides of the Atlantic. It may not be until second and possibly third-generation satellites are achieved before they can be considered wholly adequate for service in competition with the submarine cable.

Although some may regard this forecast as pessimistic, it does underline the fact that time exists for Britain to engage in useful research even if we cannot begin actively with our own satellite launcher before 1964. Clearly, reliability is not only the key to success in achieving a practical system, but also to making such a system economically worth while. The longer a satellite can remain in working order, the cheaper the overall system-cost will be.

In attaining this goal, the British electronics industry will have much to contribute. Meanwhile, the Hawker Siddeley study-project for a stabilized relay satellite, tailor-made to the Blue Streak/Black Knight launcher, should now receive serious attention.

Aviation News in General

R.C.A.F. RE-EQUIPMENT. — In addition to Canadair-built CF-104s to replace the Sabre 6 in its day-interceptor/ground-attack squadrons, the R.C.A.F. is seeking a successor to the CF-100 for all-weather interception. Plans are reported to be in hand to purchase 66 McDonnell F-101 Voodoos for the latter rôle, at a price to be adjusted according to the success of a reciprocal sale to the U.S.A.F. of 32 Canadair CL-44 transports. Canada also hopes to take over all 34 radar stations in the Pinetree early-warning chain across North America, instead of the 14 currently manned by the R.C.A.F.

ITALIAN F-104s.—The Italian Air Force is to spend approximately $80 million on the production of 50 F-104G Starfighters. Fiat will be the prime contractor assisted by other members of the Italian aircraft industry and it is likely that Alfa Romeo will produce J79s under licence. The $80 million allocation is in excess of the normal budget appropriations and will be spread over five fiscal years, starting 1960-61.

AUSTRIAN FIGHTERS. — The Austrian Air Force is to receive its first operational jet equipment with the signing of a contract with SAAB of Sweden for the delivery of 15 J-29F fighter-bombers. These are currently in service with the Swedish Air Force, and will be returned for overhaul before delivery to Austria in the spring of 1961.

NEW B.A.C. MISSILES?—According to a newspaper report, English Electric is developing a new surface-to-air missile system, Project 428, to combat low-level attacks by supersonic aircraft. Another missile mentioned is "The Bat," stated to be a ramjet-powered stand-off bomb which will deliver a nuclear warhead over 2,000 miles. It will fly at low level and take a zig-zag curve to the target to confuse defences.

CL-44 PERFORMANCE.—Balanced field take-off distance for the Canadair CL-44 freighter at 205,000 lb. is 6,800 ft., and not 7,660 ft. as originally calculated. Landing field length at 165,000 lb., the maximum landing weight, is 5,980 ft., and not 6,780 ft. as announced. These improvements will allow the CL-44 to operate into many marginal airfields.

RECORDS CONFIRMED. — Among the latest records to be homologated by the F.A.I. are some for ballooning, jet-flying, gliding, parachuting and model-flying. D. L. Piccard achieved 36,220 ft. in a small balloon in the U.S. on Jly. 24, while in Russia, on May 28, Boris Adrianov flew at 1,299 m.p.h. round a 100-km. closed-circuit course in the T-405 delta, powered by the 19,841-lb.s.t. Mk. 13 turbojet. Among the smaller jets were two Yugoslav records for speed over 15/25 km. In the Type 451-M Zolja, YU-COH, Ivan Crnjaric achieved 323.6 m.p.h., with two 330-lb. Turboméca Palas turbojets, on May 19, and Ljubomir Zekavica in the Type 451-MM Matica, with two 880-lb. Turboméca Marboré IIs, flew at 487 m.p.h. on the same date. Several light aircraft records have also been confirmed, including the closed-circuit performance of Max Conrad, who flew for 7,647 miles in a Piper Comanche between Jly. 4 and Jly. 7.

400 SAVED.—When the pilots of two R.N. Sea Hawks ejected after a mid-air collision last week off the Scottish coast at Lossiemouth, they brought the total number of successful escapes with the Martin-Baker ejection seat to 400. The first emergency ejection was made in May, 1949, by Mr. J. O. Lancaster, from the A.W.52 prototype.

MACH 5 PLUS.—Aerojet-General Corporation have received a $1m. U.S.A.F. contract to establish techniques for the design of swept-wing aerospace vehicles flying at more than Mach 5 and at orbiting altitudes. Several static and flutter models of 4 ft. span will be tested in wind-tunnels at the U.S.A.F. Air Research and Development Command's Wright Air Development Division; models will be subjected to speeds from Mach 0.8 to Mach 8, and altitudes from sea level to 300 miles.

HELICOPTERS FOR INDIA.—An Indian mission has returned from Moscow without ordering the Russian helicopters which India had agreed in principle to buy. Poor performance of the Mi-4 helicopter is said to be responsible.

TREBLE ONE AWARD.—The C. P. Robertson Memorial Trophy for the best interpretation of the R.A.F. to the public has been awarded this year to Sqn. Ldr. Peter Latham, O.C. No. 111 Squadron. Sqn. Ldr Latham received the award from Sir Lionel Heald last week during the annual reunion of the Air Public Relations Association at the R.A.F. Club.

PREP FROM SPACE.—A conference of Unesco on Nov. 19 unanimously approved a French proposal that artificial satellites should be used for transmitting recorded lessons as part of a World-wide educational programme.

GENEVA SPACE TALK.—Another meeting of the 10 West European nations concerned in organizing a joint programme of European space-research opened in Geneva on Nov. 28. U.K. delegation was led by Mr. R. N. Quirk, assistant secretary to the Minister for Science. Interchange of payload space in

CROSSED WIRES?—First intended launching of an unmanned Mercury capsule on the nose of a Redstone was frustrated on Nov. 21 at Cape Canaveral when the pylon-mounted escape rocket inadvertently fired and tore loose from the capsule. The still unlaunched Redstone, with the capsule still in place, remained firmly on the launching pad.

sounding rockets, and launching facilities, has been a topic of previous discussions in London and Paris.

BLUE WATER.—First full-range launching of the English Electric Corps-support ballistic missile, Blue Water, is expected at Woomera shortly. So far, the missile has been test-fired only from Aberporth, Wales, over a restricted range.

CHINESE BALLISTICS?—*The Times of India* has reported that the Communist Chinese are setting up missile launching sites in Tibet close to the borders of India and Nepal. Two members of Sir Edmund Hillary's Himalayan expedition are said to have seen a rocket-like vapour-trail on the Tibetan side of the Nepalese border in October.

PROJECT SAINT.—After three years' preliminary study, U.S.A.F. have now put their interceptor satellite programme, Project Saint, on a development footing. A three-year development to begin immediately provides for the launching of four target satellites and four interceptor satellites. Contracts are worth $60m.

GAGGED COURIER.—After relaying ground signals for 18 days, the U.S. Army Signal Corps active communications satellite Courier 1B, launched on Oct. 4, has broken down. It is believed that this is due to a fault in the command decoder unit, the component which switches the transmitter on and off by command. The satellite relayed more than 118 million words of teleprint during a total operating lifetime of 35 hours. The tracking beacon continues to function.

ANTI-SUBMARINE ALBATROSS.—An artist's impression of the new U.S.A.F. anti-submarine version of the Grumman SA-16 Albatross. Seen here with its MAD boom extended, the ASW Albatross will also carry sonobuoys, air-to-surface radar and ECM equipment.

Commercial Aviation Affairs

VISCOUNT SALES.—Alitalia has concluded arrangements to purchase from Capital Airlines five of the 15 Viscount 745s which were to be returned to Vickers under the terms of the United-Capital merger. Vickers anticipates little difficulty in disposing of the other 10 aircraft. S.A.S. has recently become a Viscount operator, having chartered one of the four Fred Olsen 779s previously used by Austrian Airlines.

B.O.A.C. ALL-FREIGHT.—B.O.A.C. was due this week-end to introduce its North Atlantic all-freight service, using its converted DC-7Cs (-7Fs). From Dec. 14 a twice-weekly service will be operated. B.O.A.C. is the eighth all-freight operator on the North Atlantic and the services will call at London, Glasgow and Manchester on this side and New York and Montreal in North America.

LICENSING REGULATIONS.—The Civil Aviation (Licensing) Regulations, which are the means whereby the 1960 Act will be implemented, became effective yesterday (Dec. 1), although the principal section of the Act itself is not expected to come into force until Mar. 30, next year. Details of the Regulations were contained in our issues for Jly 29 and Sept. 30.

ICAO MEMBER.—The Republic of the Ivory Coast has become the 80th member of ICAO.

P.I.A. PROGRESS. — International traffic on Pakistan International Airlines services has picked up considerably this year and there has been a 63% passenger and a 144% cargo increase on the Karachi-London run by comparison with 1959. There has also been a substantial financial improvement. Until 1959 the airline had been operated at a loss, but in 1959-60 it made a profit of more than Rs 60 lakhs (£450,000).

QANTAS ANNIVERSARY.—Mr. B. R. Patel, vice-chairman and general manager of Air India (left), presented a cake and knife to Mr. C. O. Turner, chief executive and general manager of Qantas, on Nov. 16 to mark the 40th anniversary of the Commonwealth airline. Mr. Basil Smallpeice, managing director of B.O.A.C., is seen on the right.

MORE COMETS.—B.E.A. has placed its fourth repeat order with de Havillands for Comet 4Bs. This increases Comet 4B orders from 10 to 14, including four for Olympic Airways.

ROTTERDAM GROWS.—Permission to extend the runway at Rotterdam by about 1,650 ft. to a total of 5,900 ft., has been obtained. A two-year improvement programme will include erection of a new control tower and hangar and other new buildings. Next spring British United Airways plans to introduce Viscounts on its Gatwick-Rotterdam service.

GUINEA AIRWAYS AGAIN.—A new company, Guinea Airways, has been formed for the operation of the services within Papua and New Guinea for which Ansett-A.N.A. has applied. Most services in the territory are at present operated by T.A.A. The name of the original Guinea Airways was changed recently to Airlines of South Australia; it is also a member of the Ansett group.

PHILIPPINE DISASTER.—No trace had been found, up to our press date, of the Philippine Air Lines DC-3 which disappeared on a flight from Iloilo to Manila on Nov. 23. There were 33 occupants.

SAFE RECORD.—On Nov. 9 (between 06.00 and 23.12 hrs.) Straits Air Freight Express of New Zealand (a British United associate) operated 29 return services across the Cook Straits with three Bristol 170s and lifted 261 tons.

TRANSATLANTIC RECORD.—During the first nine months of 1960 Pan American carried 6,422 short tons of cargo over the Atlantic—an increase of 46% on the 1959 figure.

PACIFIC RUNWAYS. — A new 10,000-ft. crushed coral runway has been inaugurated at Tahiti, and a 3,000-ft. extension of a similar airstrip at Biak is to be in use before the end of this year.

News About People

SILVER CITY CHANGES. — Mr. W. G. Franklin (previously commercial director) has been appointed joint managing director of Silver City Airways in place of Mr. Hugh C. Kennard, who has resigned from the company. Early last month it was announced that Mr. C. Martin Fox had been appointed joint managing director with Mr. Kennard.

MASTER PILOTS.—GAPAN has awarded Master Air Pilot Certificates to Capt. N. A. Lewis, T.A.A. line and check captain, and Capt. R. C. Griffin, based in Kuwait with British-International Airlines, Ltd.

M.o.A. INSPECTION.—Mr. F. E. McGinnety has been appointed Director-General of Inspection at the Ministry of Aviation. He has been Deputy Director-General of Inspection since 1957.

WESTERN AIRWAYS RESIGNATION.—Mr. F. G. Jeans, managing director of Western Airways and a director of Airways Union, has resigned owing to ill-health. Mr. Jeans joined the Straight Corporation (which took over Western Airways) as chief engineer in 1937. He was previously with British Airways.

TEDDINGTON DIRECTOR. — Mr. D. N. Steed has been appointed to the main board of Teddington Aircraft Controls, Ltd., as works director.

G.E.C. CHAIRMAN.—Mr. Arnold Lindley, vice-chairman and managing director of The General Electric Co., Ltd., is to succeed Sir Leslie Gamage as chairman of the company at the end of this year. Mr. Lindley will continue as managing director of G.E.C.

B.A.C. PUBLICITY. — Following reorganization of its sales and sales publicity departments, the British Aircraft Corporation has announced the following appointments: B.A.C., publicity manager, Mr. Charles Gardner; advertising manager, Mr. C. G. Hollowell; Press officer, Mr. A. C. Brothers. Vickers-Armstrongs (Aircraft), sales publicity manager, Mr. R. J. Blackburn; deputy sales publicity manager, Mr. J. H. Motum. English Electric Aviation, Ltd., Aircraft Division, sales publicity manager, Mr. A. C. Brothers; Guided Weapons Division and Instrument Wing, sales publicity officers, Mr. D. W. Morton and Mr. H. L. R. Moore. Bristol Aircraft, sales publicity officers, Mr. F. G. Clark and Mr. S. Edwards. Hunting Aircraft, sales publicity officer, Mr. D. White.

HUNTING LOSS.—The funeral of Lieut. Cdr. J. S. Overbury, Hunting Aircraft, Ltd., test pilot, took place on Nov. 22 at Dunstable R.C. Church. In addition to members of his family, many of his friends in the aircraft industry were present, Hunting Aircraft being represented by Mr. W. A. Summers, managing director, and other directors and staff. Lieut. Cdr. Overbury was killed during the previous week when his Jet Provost crashed while on a routine test flight.

SOVIET DEATHS.—The sudden death was announced on Nov. 18 of Honoured Test Pilot of the U.S.S.R., Hero of the Soviet Union, Colonel Aleksandr Grogorievich Vasilchenko. Born in 1911, the Colonel learned to fly in 1936 at the Kharkov Flying School and, after serving in various units, became a factory test pilot in 1943. He first tested the UT-2 trainer and subsequently test-flew more than 25 types. The death was also announced, on Nov. 10, of Gen. Lt. (retired) I. T. Spirin who was one of the best-known Soviet air navigators in the pre-war period. He made several long-distance flights and in 1937 headed the Soviet Air Expedition to the North Pole.

Personal Flying

THIRTY years in production and still "going strong." This is the unparalleled record of the Piper Cub which was marked by a recent ceremony at Lock Haven to celebrate the 30th anniversary of the first flight of the prototype on Sept. 12, 1930. Present at the ceremony were not only one of the earliest E-2 Cubs, which is still in regular club use, but also the test pilot who made the initial flight, Mr. George W. Kirkendall, Snr.

The first Cub was the product of the Taylor Aircraft Company, which was formed in 1928, and was powered by a 20-b.h.p. Brownbach Kitten engine. With this powerplant, which inspired the name "Cub" for the airframe, the prototype made its first five-minute hop, but it was later re-engined for production with the 37-b.h.p. single-ignition Continental A-40 flat-four. Thus powered, the E-2 Cub was certificated on Jne. 15, 1931, with a cruising performance of 50 m.p.h.

Apart from its open-sided cabin and square-cut wing and tail surfaces, the E-2 differed little from subsequent Cubs, although the latest variant has a 150-b.h.p. Lycoming, or more than seven times the original power. The Taylor Aircraft Company was bought out by William T. Piper in 1936 and renamed the following year.

Since 1930, more than 30,000 Cubs have been built, and demand for them continues unabated. The 40-b.h.p. Cub Trainer sold in its day for $995, or about £250 at that time; f.a.f. price for the Cub 150 is now $7,880.

• • •

A new air charter service is to be provided by the Oxford Aeroplane Club in the New Year, operating from Birmingham Airport. Because of the keen interest shown by businessmen in the American aircraft—mostly Piper types—operated by the club, a big demand is expected from Birmingham executives for this service.

BEECH NEWCOMER.—Developed from the smaller Travel-Air, the five-seat Model 55 Baron is a new addition to the 1961 Beechcraft range, powered by two 260-b.h.p. Continental IO-470-L engines. Economical cruise is 216 m.p.h., and gross weight 4,880 lb.

Three aircraft are to be used; a Piper Apache and two Piper Tri-Pacers. Two commercial pilots will be on hand for charter and flying instruction. For executives who want to learn to fly, tuition will be given during flights on business trips.

An official of the club has said that the services would not be cheap. By concentrating on providing up-to-date aircraft, however, the club has become one of the most financially successful in the country. Members have the choice of 12 American machines in which to do their flying.

Gliding Notes

by Dr. A. E. Slater

EACH year Charles Fauvel, designer of the AV-36 and AV-22 flying-wing sailplanes, has been awarding a "*Coupe Survol*" with three cash prizes for the best flights of the year in one of his craft. This year any type of tailless sailplane is eligible, but nevertheless the three best flights so far have been in Fauvel's machines—in fact, I cannot think of any other tailless types likely to be flying except one or two Hortens in the Argentine and the occasional "Flying Plank" in Australia and North America.

In the running for this year's first prize is Jacques Nottelet with 214 miles in an AV-22 from Dinan, by the north coast of Brittany, southwards to Cognac. Next best are Jack Lambie of California with a goal flight of 188 miles from El Mirage in an AV-36, and Michel Deswarte, 169 miles across the frontier from Lille to Duisburg during a competition in which he was beaten by an Air-102, but did better than two Fauvettes (Breguet 905 type).

M. Fauvel has sent particulars of his new AV-45 "*planeur à dispositif d'envol incorporé*," which he translates as "self-launching sailplane." He states that it takes off in under 100 metres and climbs at 4 m./sec. with the American Nelson motor—evidently that which Ted Nelson uses in his Hummingbird. There is tankage for nearly 8 gal. of fuel.

With a feathering airscrew (in course of development) the minimum sink of the AV-45 as a glider should be 0.85 m./sec. at 75 km.p.h. (2 ft. 9¼ in. at 47 m.p.h.), and its best gliding angle 1 in 26 at 85 km.p.h. (53 m.p.h.). This would be as good a gliding angle as that of the AV-36 and two-seater AV-22 sailplanes, and the sink would be the same as that of the AV-22 with two up, but greater than that of the latest model of the AV-36, which is 0.74 m./sec.

The span of the machine is 44 ft. 10½ in., aspect ratio 11.6, and all-up weight 666 lb., including 60 lb. for the motor. The wing loading is 3.83 lb./sq. ft.

So far, so good, and it remains to be seen whether every pilot who flies it will use the motor solely to reach the first available lift area, which is the only purpose of the motor in Ted Nelson's Hummingbird. Alternatively, he could fall in with Wolf Hirth's idea that an additional purpose of the "auxiliary engined sailplane" is to be able to reach an aerodrome after the lift has given out.

He could also use the motor to reach the next cumulus cloud, instead of wasting time gaining enough height to get there in a glide, which the despised "purist" would expect him to do. And the same with all subsequent clouds. However, he would be found out, for Fauvel has installed a device which stops the barograph registering whenever the motor is in action.

Another French firm, Réné Fournier, has sent a prospectus of an aircraft called RF-01, which he describes as an *avion-planeur*. An *avion* has a motor and a *planeur* has not; so which is it? It is an *avion*, and looks like one; in fact, it has the appearance of a typical light aeroplane. Its horse-power is 25, but—you've guessed it—the designer intends to install a more powerful engine. He claims a best gliding angle of 1 in 17 and a minimum sink of 1.5 m./sec., which is 6 ft./sec. all but an inch.

Now that the ultra-light people are complaining of their upper limit of 75 h.p., and want it raised to 90 or 100 h.p., another name may soon have to be found for something with a mere 25 h.p. But why *avion-planeur*? The aviation pioneers were content to call their machines aeroplanes with even less power.

Of course, if the upcurrent is strong enough you can soar any aeroplane with its motor stopped. Terence Horsley did so in a Grampian wave with a Blackburn Shark weighing nearly five tons.

* * *

BURSARIES to help young glider pilots to pay their flying fees have been offered every year since 1956 by Col. W. H. Whitbread, but many who are eligible to apply for them fail to do so and the British Gliding Association has to issue reminders at intervals. The latest reminder gives the present regulations: applicants must be 15 to 28 years old and have not yet reached Silver "C" stage; the bursaries are up to £5 and are paid over to the gliding club which credits them against course or flying fees. At a later stage pilots of up to 30 years of age may be helped by the Alex Orde fund set up in 1955 "to help young and promising pilots to reach the standard necessary to take part in World Gliding Championships."

* * *

IRELAND has now three Silver "C" pilots. The third, Jim Bellew, visited the Ulster Club's site at Magilligan, on the north coast, to complete the duration leg of five hours in a wind blowing up the cliffs. He made the distance and height legs from Baldonnel. Here the Dublin Gliding Club has installed a "pre-straightened cable" which is giving improved launches to 1,400 ft. But don't they have to post-straighten it as well?

Industry Record

Maintenance and Servicing

A new folder containing up-to-date literature on the range of aircraft ground equipment manufactured by Access Equipment, Ltd., of Hemel Hempstead, has recently been published by the company. Units described and illustrated include mobile adjustable working platforms; aluminium-alloy staging; freight loading mechanism; hydraulic working platforms; and mobile hydraulic working platforms.

The mobile adjustable working platforms, known as Safety Raisers, are employed by B.O.A.C. for powerplant servicing and the company's light-alloy staging has been used for such tasks as wind-tunnel maintenance and Comet 4 construction. A number of airlines, including B.O.A.C., Panam and Trans-Canada, use the Access freight loading mechanism in their ground vehicles and the various hydraulic working platforms are employed for aircraft assembly and maintenance.

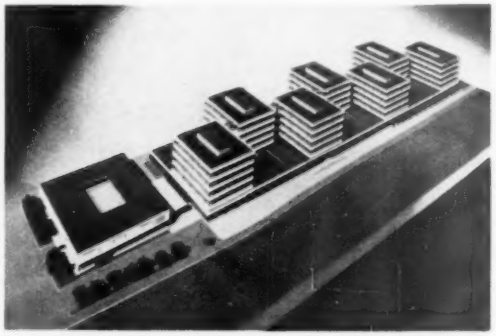
Stand-by Generating Sets

The Air Ministry has recently awarded a contract to Petbow, Ltd., for the supply and installation of eight 200-kVA stand-by mains-failure generating sets.

Four Service stations will each be equipped with two of these units and their associated equipment. The generating sets consist of Rolls-Royce Type C8TFL eight-cylinder, turbo-charged diesel engines developing 268 b.h.p. at 1,500 r.p.m. which are flexibly coupled to Macfarlane transistorized alternators with an output of 200 kVA at 0.85 power factor, 380/220V 3-phase, 50 c.p.s.

They will carry a comprehensive range of alarm systems which automatically shut them down in the event of high coolant temperature, overspeeding, low lubricating oil pressure, abnormal alternator output voltage and cessation of coolant flow. Other alarms include failure of the set to start, failure of the set to stop, low fuel, low water and alternator circuit breaker open.

Each set is capable of starting and accepting full load in less than 15 sec. in an ambient temperature of −5° C. should the mains fail. Each set is also completely self-contained and arranged to operate independently, one acting as stand-by to the other.



Work has started at Rochester on the first stage of a new electronics factory for Elliott Brothers (London) Ltd. When completed, this building will provide nearly 450,000 sq. ft. of factory and office space as shown in this drawing.

Automatic Hot Dimpling

Advantages of hot dimpling to provide crack-free dimples for flush rivets or fastenings are well known, particularly by the aircraft industry, and to exploit this process a fully automatic machine has been designed, developed and manufactured by Short Brothers and Harland, Ltd. The necessary precise operation of the dies is achieved by a pneumatic/hydraulic system and the proprietary equipment selected for this purpose was manufactured by Maxam Power, Ltd., a company within the Holman Group.

Basically, the machine consists of robust castings forming a yoke which supports the male and female dies, the latter being mounted directly on the lower jaw. The upper die, which is movable, is mounted on a hydraulic ram, which is operated by an electrically controlled pneumatic/hydraulic system. All control and setting arrangements are built into the main castings and all components are readily accessible for setting or maintenance.

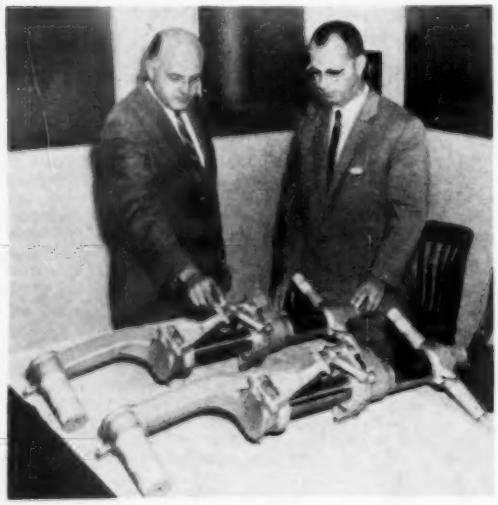
The dies are electrically heated, temperatures being controlled by a built-in thermocouple. This unit also controls the Maxam solenoid-operated pneumatic valves which operate, in conjunction with a temperature control, to exert the forming pressure in two stages. The control unit prevents initiation of the operating sequence until the dies are at the correct preset temperature, as indicated by a green light on the panel. The operator then positions the component on the tool by means of a predrilled hole and presses the foot switch.

A feature of the design is that a dimple cannot be completed until the metal has been heated to the correct temperature to ensure the desired ductile state. This is achieved by introducing two distinct phases of operation, which are completed at different pressures. The first stage, which is initiated by the operator, brings the dies into contact with the component at a preset pressure. When the metal has reached a predetermined stage of deformation under this initial pressure and the heat supplied by the dies, the pneumatic circuit is changed over so that the hydraulic pressure on the ram is increased considerably for the final stage of dimpling and is maintained at this higher setting for a controlled period.

Aircraft Material Specification

A new standard in the aircraft series, "S.124.—Corrosion resisting chromium steel (free machining)" has been announced by the British Standards Institution. The publication replaces the Ministry of Aviation specification D.T.D. 525.

During the transfer of this specification, the opportunity has been taken to introduce certain technical changes; in particular the standard now specifically requires that the steel shall not contain lead or selenium. Copies may be obtained from the B.S.I., Sales Branch, 2 Park Street, London, W.1, price 2s. 6d.



Under a production sharing agreement, Lockheed has placed substantial orders with Dowty Equipment of Canada for the manufacture of nose landing gear for the F-104 Starfighter. Dowty Canada is also producing nose landing gear for the R.C.A.F. version of the Starfighter to be built by Canadair at Montreal. Here the first two Dowty-built nose undercarriage struts are being handed over to Mr. J. Frostrom, representing Lockheed.

Power Jets

The consultancy services of Power Jets (Research and Development), Ltd., are described in a new booklet recently published by the company. These cover all the technological aspects of gas turbines and rotary thermodynamic machinery developments, including gas turbines, axial and centrifugal compressors, axial and radial flow turbines and expanders, turbines for use with free piston gasifiers, control systems for compressors and turbines, heat exchange equipment, specialized applications of turbo machinery and pressure exchangers.

Powet Jets consultancy department is now located at The Croft, 112 Church Lane East, Aldershot, Hants. The company's registered office is still at 25 Green Street, London, W.1.

Correspondence

An Historical Film

REGARDING the recent correspondence about "The Flying Years," it may be interesting to recall that S. F. Cody won the first prize of £5,000 in the Military Trials on Salisbury Plain in 1912, competing against leading British and European constructors of aircraft, and I believe, if memory serves me right, that he also won one of the Michelin cross-country trophies. Even in 1911 he was one of the few to finish in the *Daily Mail* circuit of Britain race, though a long way behind the winner.

I can still picture him passing over Ascot on at least two occasions in the 1912-1913 period flying strongly, and with his 60 h.p. Green engine, which I think he had then installed, giving a healthy roar.

To me "The Flying Years" was disappointing, as I suppose it was bound to be, in that it endeavoured to cover so great a subject in the space of four small half-hourly programmes, though Sir Alan Cobham very enthusiastically did his utmost to depict the tremendous progress in the past half-century.

To one who still retains precious memories of those early days at Brooklands and elsewhere before the First World War, I cannot but wish that an historical film might be produced giving much more space to the great pioneer pilots and machines of those bygone days, and very accurately edited.

It has always been my hope, too, that a book might one day be written, somewhat perhaps on the lines of Geoffrey Dorman's "British Test Pilots," giving details of their lives, their background and what manner of men they were. Amongst the heroes of my youth was Gustav Hamel whose flying feats shone brightly in those days before his loss over the Channel in May, 1914.

We read much about his flying in the Press of those days, sometimes watched him fly, when opportunity occurred (I remember walking beside him and his machine after he had landed at Brooklands, on that great occasion in 1913 when Pegoud first demonstrated looping and upside-down flying).*

Then came that sad day when he vanished from our ken, and I have often wished it were possible to know more about the man himself as well as of the flying feats he accomplished. I still cherish photographs of him and his machines taken from flying periodicals of those days.

Ascot, Berks. W. M. BUNCE.

* I was taken to Brooklands as a child in 1913 to see someone fly upside-down and was much impressed by Gustav Hamel's crazy flying—I thought the tiny aeroplane so high in the sky was a toy kite tumbling down after the string had broken. But was it Pegoud who did the upside-down flying?
—T.J.

An Operational Cargo-handling System

THE survey of "Airport Installations and Cargo Handling" (Oct. 14) was useful and should become an annual feature. H. A. Taylor seems to have been influenced by the sales brochures in front of him when he prepared "Integrating the Air-Freight Effort." His statement that "Canadair have probably gone a good deal further in terms of practical development than any other manufacturer" ignores the operational Douglas C-133 and its cargo-handling system. The CL-44 is still just a conversion of an original passenger-carrying aircraft to a freight design, and an aircraft which visualizes construction of a new freight warehouse at every airport to permit second floor handling of cargo cannot be the most "practical" answer.

Because the C-133 was built to a military requirement, its fine cargo features may not be familiar to many of your readers. As a result of Project 163L, the U.S.A.F. has adopted a lightweight, aluminium-honeycomb-filled pallet that measures 9 ft. by 10 ft., which is compatible with both the C-124, C-130 and the C-133. Standard aluminium skate-wheel conveyor sections are attached to the tie-down fittings in the aircraft to permit movement of the pallets without requiring mechanical assistance.

General cargo is secured to the pallets with nets before the aircraft arrives. Bulky cargo may be moved into the aircraft on its own dolly in the case of aircraft engines, or may be secured to a pallet with straps, cables or chains. For over two years this system has been operationally tested with a conveyor bridge from warehouse to C-133 at Dover AFB, Delaware, and the use of standard 40-ft. flat bed trailers with permanently attached warehouse conveyors at Chateauroux AS, France. The prototype system was also tested on regular flights to Thule, Greenland, and is now in use in the Pacific area.

Two guide-rails run the length of the aircraft, and prevent the pallets from turning while being pushed into place. When the pallet is in place, aircraft tie-down is accomplished by simply lifting two locking levers in the guide rail on each side of the pallet which securely holds the pallet in place under all flight conditions.

The pallets may be placed end to end or spaced as dictated by the specific load and by weight and balance conditions. Although the pallets will carry 10,000 lb., in practice an average of 8,000 lb. has proved most satisfactory. A maximum of 11 pallets may be placed in the C-133.

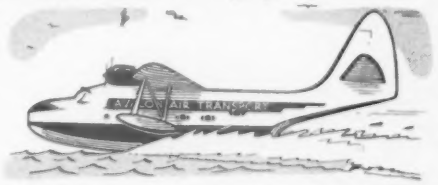
A particularly interesting shipment which could not have

Groundabout

Names and Things. Aviation and Wrens seem to be forever together. Fledgling Wren goes to a school and what do we find? The houses are named Lancaster, Lincoln and York and the headmaster is a Mr. Ewart, only one syllable away from Roy Ewans, Avro's chief designer. Almost unbelievably, the board of directors does not have anybody named Dobson on it. Young Christopher has just pointed out that the names Lanc., Linc., and York also have *other* connotations. Next he'll be saying that 748 is a number.

*

Web-Foot Dept. "The shortest airline with the longest runway," so claim Avalon Air Transport, who operate flying-boats on the 45-mile hop between Long Beach, California, and Catalina Island. Especially pleasing is that as well as five Grumman Goose amphibians, they fly a 20-year-old Vought-Sikorsky VS-44A (four Pratt & Whitney Twin Wasps). The fascinating story of how Avalon's president Dick Probert salvaged and flew it from Lima, Peru, to Long Beach, is told in United Aircraft's *Bee-Hive* in an article beginning "I was minding my own business and making money, when the phone rang." Just to add a touch of grace and sentiment to this graceless column, here is Avalon's flagship:



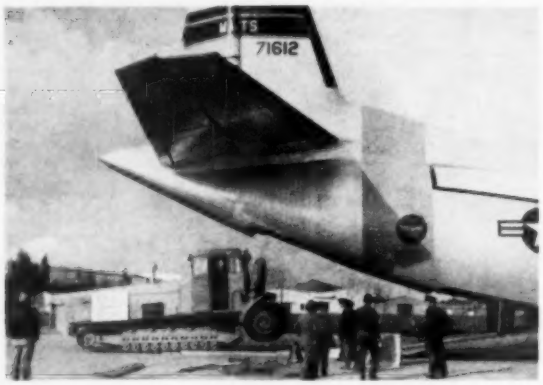
*

Swordfish and Tinfish. Speaking of liquid aviation, Mr. A. Edwards, an ex-R.A.F. instrument maker, has recalled, in *R.A.E. News*, the old Swordfish torpedo-dropping experiments. He explains that impact with the water closed a flap under the torpedo which turned on the compressed air and started the engines driving its propellers. Sometimes the release mechanism would jam and when the Swordfish landed back at Gosport the torpedo would be jolted off, leap into life and wriggle along the ground like a demented snake. Gp. Capt. Tim Coleman once chased a wriggler, yelling for a key to turn off the air supply. However, I'd say their finest hour was when Wg. Cdr. Louis Grieg torpedoed the station cricket pavilion. The Unit also developed the wing-mounted, downward-inclined two-spotlight system for judging height at night, afterwards recommended by Sir Ben Lockspeiser to the "Dam Busters" and used in their raids.

*

Doing it the Hard Way. Warrant Officer S. Bushell, Cpl. K. Bayliss and 200 natives have, with the sweat of their brow, just picked and shovelled a 3,000-ft. by 50-ft. runway out of dense vegetation and palms on Hulele, a coral island in the Maldives, and laid 700 tons of perforated steel planking. In four months. All credit to them. But can you imagine the Americans working like that, using native canoes and making do? There'd have been a massive air-lift, dropping bulldozers, graders, Officers Club, air-conditioned married quarters and the rest of it. And they would have done the job almost as quickly, too.

by Gyrfalcon



been accomplished by any other aircraft was the recent flight of two Swiss-built snow milling machines from France to Christchurch, New Zealand, for use in Antarctic exploration. The two C-133s are said to be the largest aircraft yet seen in New Zealand. One of the machines is illustrated in the photograph above.

Chateauroux, Indre, France. B. G. DUDLEY, (Captain, U.S.A.F.)

The Beam in Dai Bach's Eye

IN your issue for Nov. 18 there is a letter signed "Dai Bach" which criticizes one of your contributors for the quality of his English. "Dai Bach" should set his own house in order first. He should remember that good English must appeal to the ear, even though written. His phrases "a hook on which to hang" and "pitfalls into which writers fall" are grammatically correct—painfully so—but sound horrible, whether in or out of context. His worst effort, however, is this:—

> "It is appreciated that very little technical material can be written without using the particular terms peculiar to the subject discussed."

He is blunting the point he wishes to make, as well as offending the ear. Why not this?

> "I appreciate that technical material cannot be written without using the terms peculiar to the subject."

As an alternative to Fowler, I recommend that "Dai Bach" should read—from cover to cover—Rickard's "Technical Writing." This is an American book, first published in (I believe) 1911, but still obtainable. It is, in my opinion, one of the best books ever produced on the writing of clear, simple English.

Accra, Ghana. C. B. GAVIN-ROBINSON.

Hawker's Spirited Lead

IN "Matters of Moment," page 676, of THE AEROPLANE AND ASTRONAUTICS for Nov. 18 you refer to European VTOL and NATO.

In this article you infer that the Hawker P.1127 may have a somewhat gloomy future. This, you say, can be deduced from the forthcoming revision early next year of the NATO specification for a subsonic strike aircraft capable of vertical take-off and landing, to demand supersonic performance. You continue by saying that it is thought that the subsonic speed of the P.1127 will make it vulnerable to opposing fighters.

That is a provocative and debatable thought but no doubt one that is strongly supported by the competitors to the splendid Hawker effort. You have already reported that Hawker's have started flight trials with their potentially operational P.1127. Let us hope, let us *all* hope and pray, that this spirited lead will receive the strongest support from our Ministry of Aviation, Air Ministry—and aeronautical correspondents.

What a shot in the arm it will be to British aviation if the Royal Air Force becomes the first air force in the World to be equipped with low-level, high-speed—possibly transonic—strike reconnaissance V/STOL aircraft! While our competitors are struggling to achieve supersonic V/STOL flight at the first attempt—which will doubtless involve them in terrifying expense, sophisticated aircraft and costly delays—the Royal Air Force and our industry would be forging ahead gaining invaluable experience which would contribute so much to our winning eventual success in the realms of truly supersonic V/STOL aircraft.

East Horsley, Surrey. J. CRAMPTON.

Publications Received

AGARD Aeronautical Multilingual Dictionary. Edited by G. H. Frenot and A. H. Holloway. This newest publication from the Documentation Committee of the NATO Advisory Group for Aeronautical Research and Development is of major importance, comprising the terms contained in the British Standards Institution BS185 *Glossary of Aeronautical Terms* translated into Dutch, French, German, Italian, Spanish, Turkish and Russian, with a number of American equivalents added to the English terms. The dictionary is fully indexed to allow its use in translating from any one of the eight languages to any other, and is presented in loose-leaf form to permit its periodic revision. The first amendment, comprising 1,287 additional new terms, is already being prepared. Published for AGARD by Pergamon Press. Price £7 net.

"The Aeroplane" Pictorial Review (No. 5). Contains a wide selection of photographs chosen from the pages of THE AEROPLANE AND ASTRONAUTICS in the past 12 months to illustrate aviation progress. 128 pp.; 10½ in. by 7½ in. Temple Press Limited. Price 12s. 6d.

Air BP Book of Flight Today. Edited by John W. R. Taylor. A series of reprints from *Air BP*, the house journal of the company of that name, making interesting general reading. 108 pp.; 9½ in. by 11½ in. Illustrated. Stanley Paul and Co. Price 21s.

Aviation Calendar

Dec. 2

Cheltenham.—British Institution of Radio Engineers South Midlands Section lecture, "The Place of the Electric Rocket in Space Propulsion," by W. A. S. Murray, at North Gloucestershire Technical College, at 19.00 hrs.

London.—R.Ae.S. Lecture Theatre Opening Ceremony, by Lord Brabazon of Tara, at 4 Hamilton Place, W.1, at 19.00 hrs.

Dec. 6

London.—R.Ae.S. Astronautics and Guided Flight Section lecture, "Solid Propellent Rocket Motors," by Dr. G. H. S. Young and Dr. W. R. Maxwell, in the Lecture Theatre, 4 Hamilton Place, W.1, at 18.00 hrs.

Dec. 7

London.—Kronfeld Club lecture, "Air Transport in Brazil," by W. N. Tonkyn, in the Basement, 74 Eccleston Square, S.W.1.

London.—British Institution of Radio Engineers Radar Group lecture, "Flight Evaluation of Airborne Electronic Equipment," by H. G. Hinckley, at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1, at 18.30 hrs.

London.—R.Ae.S. Agricultural Aviation Group lecture, "Grass, Soils and Fertilizers," by I. A. Nicholson, in the Lecture Theatre, 4 Hamilton Place, W.1, at 19.00 hrs.

London.—GAPAN Livery Dinner at the Innholders' Hall, College Street, E.C.4, at 19.45 hrs.

Dec. 8

London.—R.Ae.S. Symposium on Supersonic Transport Aircraft.

Dec. 9

London.—R.Ae.S. Man Powered Aircraft Group lecture, "Aerodynamic Problems of Man Powered Flight," by T. R. F. Nonweiler, in the Lecture Theatre, 4 Hamilton Place, W.1, at 19.00 hrs.

Dec. 10

Birmingham.—British Interplanetary Society Midlands Branch lecture, "Legal Problems in the use of Outer Space," by J. A. Andrews, in the Birmingham and Midland Institute Cinema, Paradise Street, at 18.30 hrs.

Dec. 12

London.—R.Ae.S. Historical Group lecture, "Some Problems of Aeronautical History," by C. H. Gibbs-Smith, in the Lecture Theatre, 4 Hamilton Place, W.1, at 19.00 hrs.

Company Notices

NEW COMPANIES

AIRCRAFT UNIT ENGINEERING CO., LTD. (675,083).—Private co. Reg. Nov. 15. Cap. £10,000 in £1 shs. General aeronautical and precision engineers. Directors: Wm. W. Lyle, and Giulia M. E. T. Lyle, both of Cotswold, Kentish Lane, Brookmans Park, Hatfield, Herts. Sec.: Giulia M. E. T. Lyle. Sols.: H. B. Wedlake Saint and Co., W.C.2. Reg. office: 18-19 Greenhill Parade, New Barnet, Herts.

C. A. WRIGHT, LTD. (675,112).—Private co. Reg. Nov. 15. Cap. £5,000 in £1 shs. Dealers in and charterers of aircraft, etc. Sec.: Thomas A. Herbert. Reg. office: 14 The Avenue, Colchester.

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858,596.—**Cargon Holdings, Ltd.**—"Apparatus for conveying freight and other loads by aircraft."—Apr. 24, 1957. (Dec. 10, 1956.) (Divided out of 13105/57.)

Printed specifications of the above will be available on Jan. 11, 1961, and the opposition period will expire on Apr. 11, 1961.

Personal Notices

BIRTHS

Costley.—On Nov. 13, at R.A.F. Hospital, Wroughton, to Judith (*née* Franklin), wife of Flt. Lt. J. M. Costley—a son.

McCullagh.—On Nov. 19, at R.A.F. Hospital, Wroughton, to Amaryl (*née* Dowling), wife of Flt. Lt. E. A. McCullagh—a daughter.

Stavers.—On Nov. 12, at B.M.H. Dhekelia, Cyprus, B.F.P.O. 53, to Betty, wife of Flt. Lt. L. W. Stavers—twin sons.

Thompson.—On Nov. 2 at Haverfordwest, to Priscilla (*née* Hett), wife of Lieut. G. W. M. Thompson, R.N.—a son.

Veale.—On Nov. 10, at R.A.F. Hospital, Ely, to Diana (*née* Sayce), wife of Sqn. Ldr. Arthur Veale—a daughter.

DEATHS

Alexander.—On Nov. 16, Wg. Cdr. Norman G. Alexander, M.C., R.A.F. (Retd.)

Wilkinson.—On Nov. 21, Flt. Lt. William Wilkinson.

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FROM OVERSEAS AVIATION (C.I.), LTD., OF 6 YORK STREET, ST. HELIER, JERSEY, C.I.:—

APPLICATION NO. 4630 for a seasonal Normal Scheduled Service with Argonaut and Ambassador aircraft for the carriage of passengers and supplementary freight between Jersey and Brussels at an initial frequency of two return flights weekly increasing later in accordance with traffic demand from May to October each year for seven years from the date of approval.

FROM STARWAYS, LTD., OF LIVERPOOL AIRPORT, LIVERPOOL, 24:—

APPLICATION NO. 4631 for a seasonal U.K. Internal Service with Dakota aircraft for the carriage of passengers, supplementary freight and mail between Glasgow (Renfrew) and Jersey, at an initial frequency of four return flights weekly increasing later in accordance with traffic demand, from May to October each year for seven years from 1961.

FROM EAST ANGLIAN FLYING SERVICES, LTD., OF SOUTHEND AIRPORT, ESSEX:—

APPLICATION NO. 3457/1 for an amendment to the terms of approval of the Vehicle Ferry Service which they are authorized to operate with Bristol 170 aircraft for the carriage of vehicles and associated passengers only between Bristol and Cork at a frequency in accordance with traffic demand until September 30, 1963, so as to enable them to operate also with DC-4/ATL98 aircraft and to carry supplementary freight and 25 incidental passengers daily.

These applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on July 30, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. 563-6

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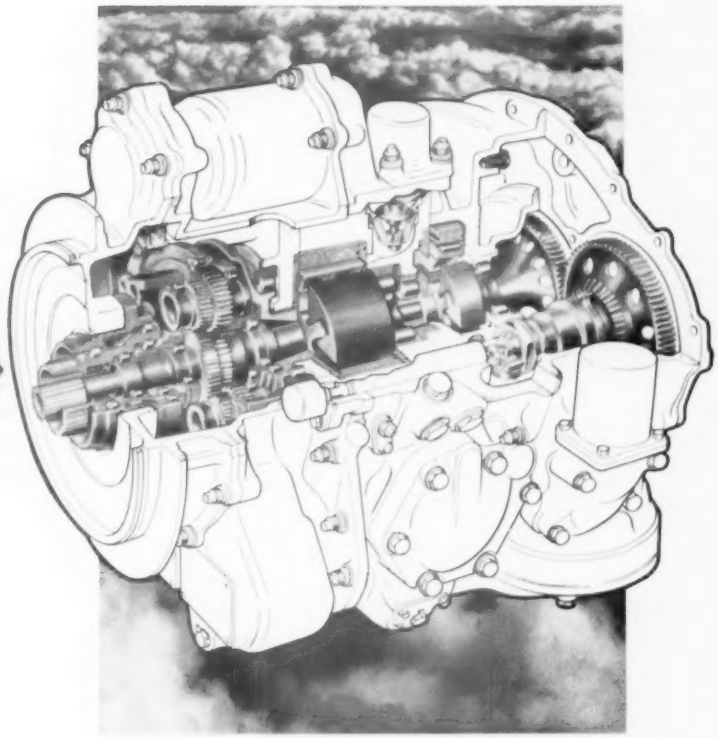

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